BOONTON SIGNAL GENERATOR

MCDONNELL DOUGLAS
CORPORATION

OPERATING INSTRUCTIONS

FOR THE

SIGNAL GENERATOR
TYPE 202-E FM-AM

BOONTON RADIO CORPORATION

BOONTON, NEW JERSEY

U. S. A.

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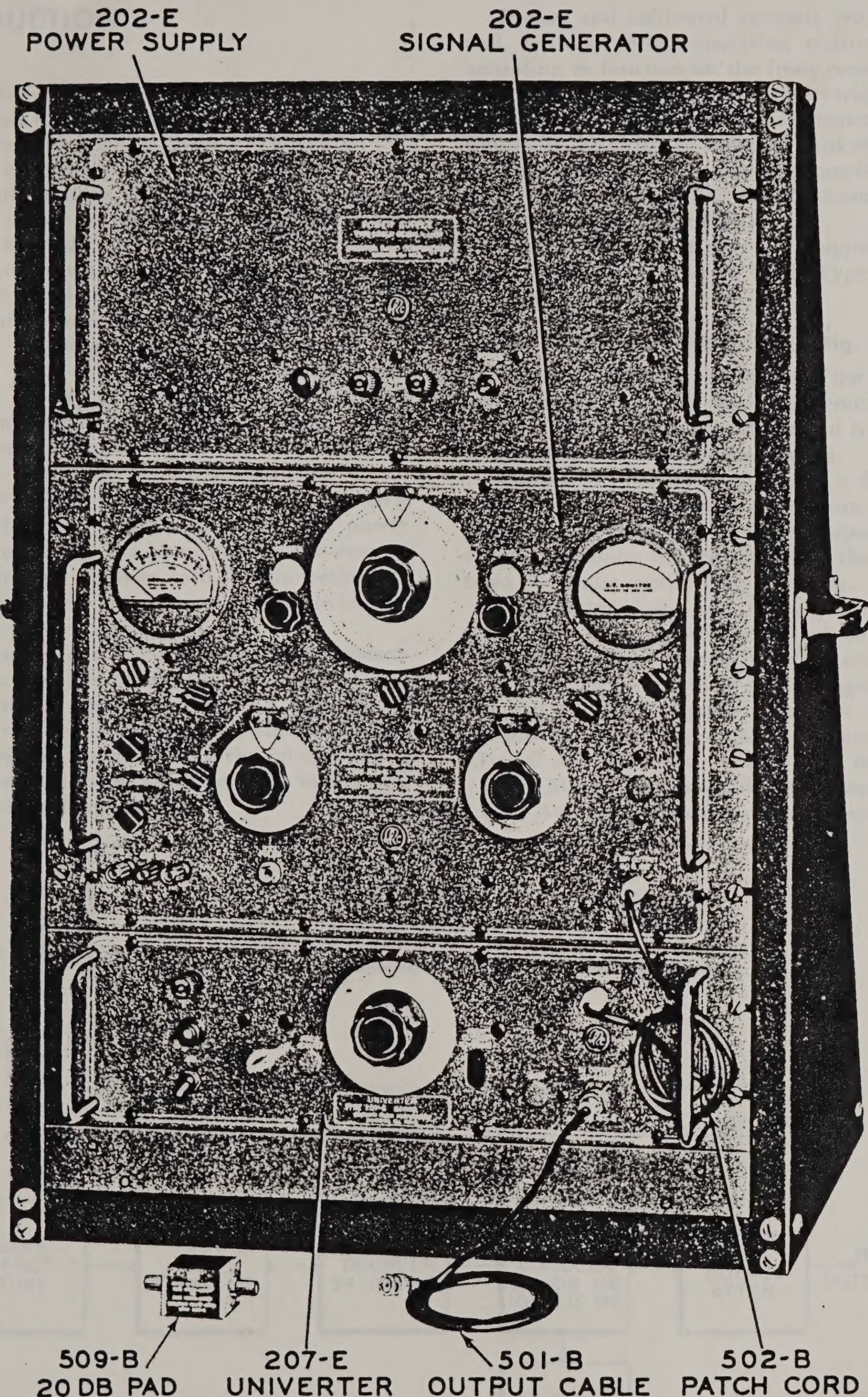


Fig. 1 Rack Mounted View of FM Signal Generator 202-E with Power Supply and Accessory Univerter 207-E

I. INTRODUCTION

GENERAL

The type 202-E Signal Generator has been specifically designed for use in the development and testing of frequency modulated receivers and television FM sound channel equipment within the frequency range of 54 to 216 megacycles. Provisions have also been made whereby it may be used in this frequency range as an amplitude modulated RF signal source or, in conjunction with an external audio oscillator, may be used to produce simultaneous FM and AM RF signals.

Physically this instrument consists of two major assemblies: the signal generator proper and the DC power supply. Each of these assemblies is contained within its own cabinet. The cabinets are so designed that the units may be used as bench type equipment or quickly converted for mounting in a standard 19 inch rack.

In operation the two units are electrically connected by a multi-conductor cable from the rear of the power supply which mates with a connector at the rear of the signal generator. A power cord for connecting the instrument to a suitable line source is also provided at the rear of the power supply.

The generator proper consists of three sub-assemblies: (1) front panel assembly, (2) RF assembly, and (3) audio oscillator assembly. The RF assembly is secured to the rear of the front panel while the audio oscillator is mounted on the side of the cabinet and is electrically connected to the front panel by means of a cable and plug-socket connection.

Meters and calibrated controls are direct reading and, with all other operating controls, are located according to function on the front panels of the units.

The wiring and layout of the various components have been arranged for best performance and maximum simplicity, resulting in compact units of moderate size. For convenience in carrying and protection of the front-panel controls, two utility handles have been provided on the front panel of each unit.

This instrument is supplied complete with tubes, instruction manual, and RF Cable Type 501-B.

BASIC OPERATING PRINCIPLES (Fig. 2)

Figure 2 shows in block form the basic elements employed in the 202-E Signal Generator. A type 6C4 triode is used as an RF oscillator and is tuned over the frequency range of 27-54 megacycles.

Coupled to the RF oscillator is a 6AK5 reactance tube which for frequency modulation, shifts the frequency of the oscillator in direct proportion to the instantaneous audio voltage applied to the reactance tube from the audio modulating oscillator.

The output from the RF oscillator is fed to a Class C frequency doubling stage which is tuned to the second harmonic of the oscillator frequency, thus covering a frequency range of 54 to 108 megacycles. Following this doubling stage is an output stage which in the low frequency range (54 to 108 mc) operates as a Class C amplifier and in the high frequency range (108 to 216 mc) becomes a Class C frequency doubling stage. Amplitude modulation is obtained at this stage

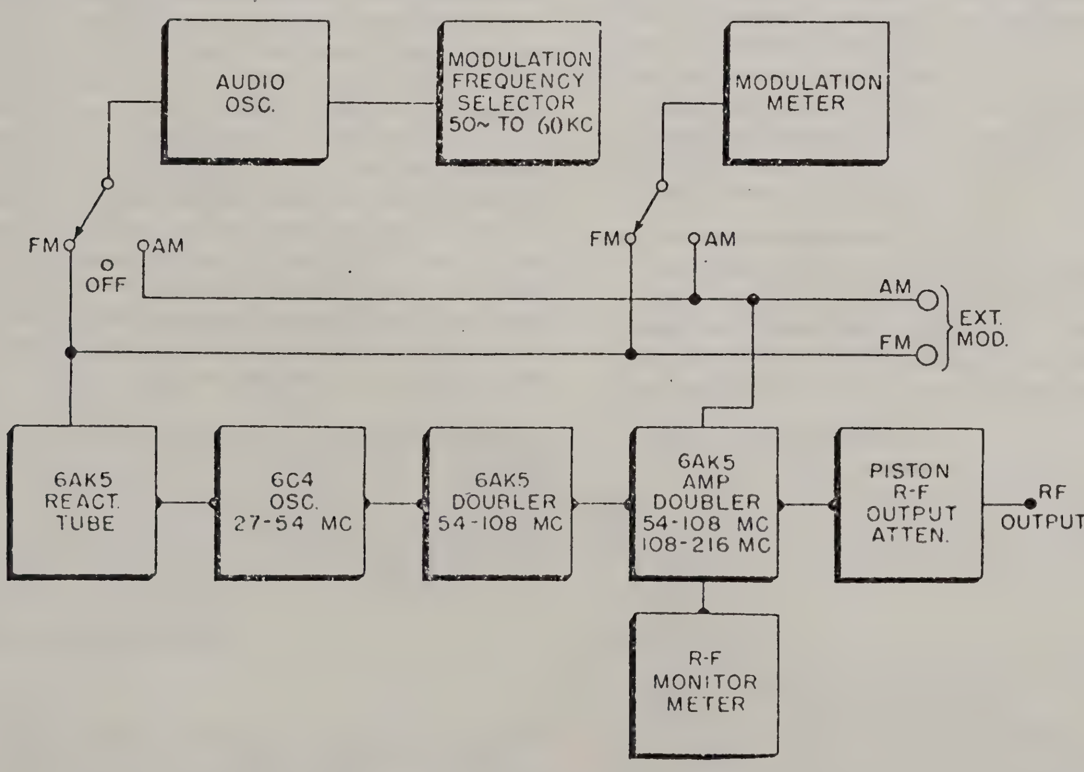


Fig. 2 Basic Elements of 202-E FM-AM Signal Generator

by applying an audio modulating voltage to the screen of the 6AK5 tube.

Coupled to the plate inductor of the output stage is a piston type mutual inductance attenuator having a 50-ohm resistor in series with the one turn coupling loop.

The dial of the attenuator is calibrated in microvolts in terms of the voltage present at the output cable terminal posts when the power output from the last stage is set to the proper level as indicated by the output monitor meter.

The 50-ohm RF output cable is terminated at one end by a 50-ohm resistor and terminal post assembly and at the other end by a BNC type connector which attaches to the RF panel jack. The output impedance of the generator with this cable connected is 25 ohms. The voltage appearing across the output cable terminal posts is read directly on the output attenuator dial.

PRELIMINARY INSTRUCTIONS

The instrument should be carefully removed from the packing carton and the cable from the power supply connected to the signal generator. Connect the power cord to a suitable 115 volt, 50-60 cycle outlet. Operate the Power Switch to the "ON" position. Attach the 501-B Output Cable to the front panel RF Output Jack by pushing in on the cable connector and rotating it clockwise.

Operation of the RF Monitor Control should cause the pointer of the RF Monitor Meter to move. It should be possible to set the meter pointer to the red reference mark over the entire frequency range from 54 to 216 megacycles. This is an indication that the RF oscillator and amplifiers are working properly.

To check the FM and AM modulating systems, turn the Modulation Selector Switch to FM, the Modulation Meter Switch to FM, and the Deviation Range Switch to 24 kc., 80 kc., or 240 kc. Operating the FM Deviation Control in a clockwise direction should cause the Modulation Meter to read increasing deviation. Switch the Modulation Selector Switch to AM, the Modulation Meter Switch to AM, and rotate the Amplitude Modulation Control clockwise. The Modulation Meter should read the degree of amplitude modulation present and full-scale setting should be possible in all but the 60 kc position of the Modulation Frequency Switch.

To prepare this instrument for rack mounting it is necessary only to, (1) remove the externally available screws securing the two end-bells to the cabinets, (2) remove the end-bells exposing the rack mounting holes in the front panels, and (3) remove the four rubber feet from the bottom of each cabinet.

II SPECIFICATIONS

RF Range

Overall frequency coverage of 54 to 216 megacycles in two ranges: 54-108 megacycles and 108-216 megacycles, accurate to within ± 0.5% after a warm-up period of one hour. The main frequency dial is also calibrated in 24 equal divisions for use with the vernier frequency dial.

Vernier Frequency Dial

The vernier frequency dial is divided into 100 equal scale divisions and is mechanically coupled to the main frequency dial by a 24:1 gear train, providing about 2300 logging divisions over each frequency range. The approximate frequency change per vernier division is 26 kc on the low range and 52 kc on the high range.

Fine Tuning Range

The fine tuning control permits continuous tuning over a range of approximately ± 10 kc in the 54 to 108 mc range and ± 20 kc in the 108 to 216 mc range. No calibration is provided.

Incremental Frequency Range

The ΔF switch permits tuning in frequency increments of 0, ± 2.5, ± 5, ± 7.5, ± 10, ± 12.5, ± 15, ± 25, and ± 30 kc in the 54 to 108 mc range and twice these values in the 108-216 mc range. The relative accuracy of the increments is ± 1½%. Overall accuracy is dependent upon the accuracy of the 60 kc modulating frequency (108-216 mc range), and is within ± 6% when the 60 kc accuracy is ± 2% or better, at the carrier frequency checked.

RF Output Voltage

The maximum open circuit output voltage from the BNC type RF output jack at the front panel is about 0.4 volt. With the standard output cable (type 501-B) attached, the maximum calibrated output voltage at the cable terminals is 0.2 volt. When the RF monitor meter is set to the red calibration line and the standard output cable attached, the RF output attenuator is direct reading in microvolts and continuously adjustable from 0.1 microvolt to 0.2 volt. Accuracy is approximately ± 10%.

RF Output Impedances

The RF output impedance of the signal generator as seen looking into the BNC type front panel connector is 50 ohms resistive. With the standard output cable attached, the RF output impedance as seen looking into the output cable terminals is 25 ohms resistive.

Frequency Modulation

Three frequency deviation ranges 0-24 kc, 0-80 kc, and 0-240 kc are provided, each continuously adjustable. Calibrated increments are 1 kc on the 24 kc range, 5 kc on the 80 kc range, and 10 kc on the 240 kc range.

FM Distortion

The overall FM distortion at 75 kc is less than 2% and at 240 kc is less than 10%.

These distortion percentages apply when the front panel fine tuning control is set midway in rotation and the ΔF control at zero electronic deviation, or

when the sum of the fixed deviation and modulation deviation do not exceed the stated deviations.

Amplitude Modulation

1. Internal Modulation: Utilizing the internal audio oscillator, amplitude modulation may be obtained over the range of 0-50%, with meter calibration points provided at 30% and 50% modulation points.

2. External Modulation: Using an external audio oscillator, the RF carrier may be amplitude modulated to 50%.

3. Pulse Modulation: A front panel jack is provided which permits direct connection of an external modulation voltage source to the screen of the final stage for pulse and square wave modulation. When this connection is made the modulation meter and internal circuits are disconnected from the screen element. Approximately 75 volts is required to maintain the carrier at its normal level and about minus 3 volts will shut the carrier off.

AM Distortion

Overall distortion is less than 5% at 30% modulation and less than 8% at 50% modulation.

Fidelity Characteristics

The deviation sensitivity of the FM modulation system as a function of frequency is flat within ± 1 db from 30 cps to 200 kc.

The amplitude modulation system, with the modulation potentiometer at maximum position, is flat within ± 1 db from 30 cps to 200 kc. With the modulation potentiometer at one half of full rotation, the amplitude modulation system is flat within ± 1 db from 30 cps to 70 kc.

Direct connection to the screen element of the final output stage permits square wave or pulse modulation to be applied from an external voltage source. Under these conditions the rise time of the modulation carrier envelope is less than 0.25 microseconds and the decay time less than 0.8 microseconds.

Spurious RF Output

All spurious RF output voltages are at least 30 db below the desired fundamental.

Signal-to-Noise Ratio

The signal-to-noise ratio referred to the level established by 10 kc deviation is better than 60 db in a quiet location. Where considerable noise and vibration are present, the ratio may drop to 55 db.

Frequency Stability

Less than 0.01%/hr. after 2 hour warmup.

Internal AF Oscillator

The internal AF oscillator may be switched to provide either frequency or amplitude modulation; it may also be switched off.

The internal AF oscillator provides eight fixed frequencies which may be selected by a rotary switch, — 50, 100 and 400 cycles, and 1, 5, 7.5, 10 and 60 kc. The 60 kc frequency is provided for calibration of the Incremental Frequency Switch only. Frequency accuracy is within 5% on all but 60 kc, where accuracy is ±2%.

The output of the internal oscillator is available (at the external binding posts) for synchronizing or other applications if desired. Approximately 5 V on the FM posts and 50 V on the AM posts are available.

External Modulation Requirements

1. Frequency Modulation.

The frequency deviation sensitivity is 50 kc per volt on the 0-240 kc deviation range and 16.6 kc per volt on the 0-80 kc deviation range. For external FM the input impedance is 1500 ohms maximum.

2. Amplitude Modulation.

Approximately 45 volts is required for 50% modulation on either the high or low RF range. For external AM the maximum input impedance is 7500 ohms shunted with 1000 mmf.

Simultaneous FM and AM

For certain tests simultaneous FM and AM is sometimes desired. The 202-E FM-AM Signal Generator, in combination with an external low distortion audio oscillator, may be used for this purpose provided that the audio oscillator is capable of developing approximately 5 volts across a 1500 ohm load, the FM requirement for 240 kc deviation.

In use the external audio oscillator is connected to the FM external binding posts, the modulation selector switch set to AM, and the levels of each type of modulation independently set on the modulation meter by operation of the modulation meter switch, FM deviation control, and amplitude modulation control.

CAUTION:

Operation of an external amplitude modulated audio oscillator at a frequency which is the same as or near the audio frequency of the frequency modulated internal oscillator will result in interaction between the modulation circuits.

Power Supply

A separate external power supply furnishes all the dc potentials required for the operation of the 202-E Signal Generator. Output voltages are 250, 150 and 6.9 volts dc, with ripple contents averaging 15 millivolts, less than 1 millivolt, and 25 millivolt, respectively.

Power Requirements

Input to separate power supply: 80 watts at 115 volts, 50 to 60 cycles. For best stability a regulating transformer should supply input power.

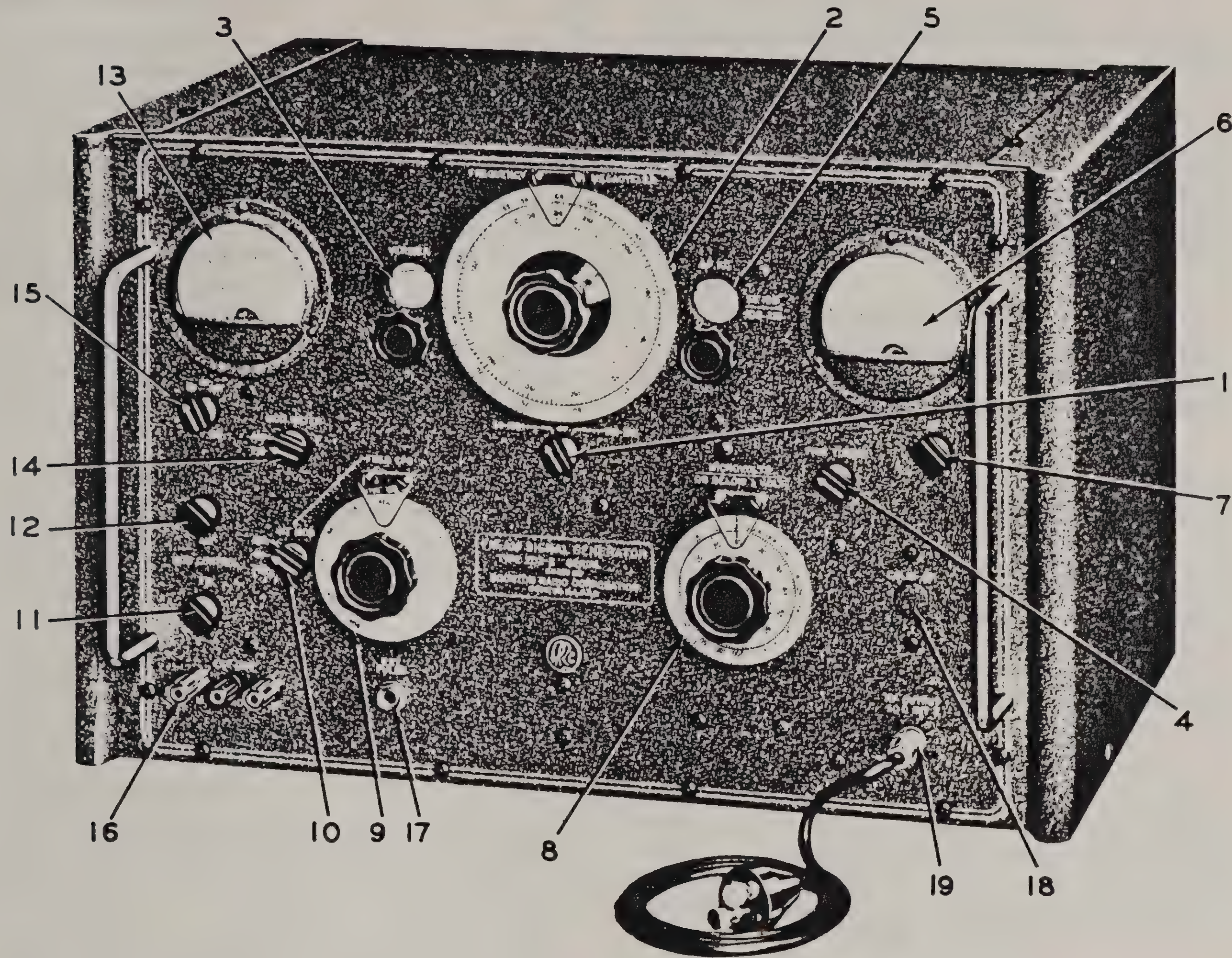


Fig. 3 Front Panel Controls and Layout

Tube Complement

Audio Oscillator	6AU6, 6V6GT/G	(V1, V2)
Rectifier	5Y3GT/G	(V3)
Voltage Regulator	OD3/VR-150	(V4)
Reactance Modulator	6AK5*	(V5)
RF Oscillator	6C4*	(V6)
Doubler Stage	6AK5*	(V7)
Doubler and Output	6AK5*	(V8)
Ballast Resistor	6H-6	(R16)

*Specially Selected. See parts list.

Dimensions

L — 19¼" W — 12 5/16" Depth — 10⅞"

Weight Generator 31 lbs.
Power Supply 27 lbs.

III. OPERATING CONTROLS

POWER SUPPLY (Fig. 1)

Power Switch

This switch applies power to the circuits when in the "ON" position.

Fuses

Two fuses, one in either side of the power transformer primary, to protect the instrument. They are replaceable from the front panel.

Pilot Lamp

A red lamp, which when lit indicates that the circuits are energized. The bulb is replaceable from the front panel.

SIGNAL GENERATOR (Fig. 3)

1. RF Range Switch.

This control selects either the low frequency range, 54-108 megacycles, the high frequency range, 108-216 megacycles, or turns the RF carrier off.

2. Main Frequency Dial.

The Main Frequency Dial has two frequency calibrations, 54-108 megacycles and 108-216 megacycles. An inner scale is divided into 24 equal divisions for use with the Vernier Frequency Dial.

3. Vernier Frequency Dial.

This dial is divided into 100 divisions and is coupled to the Main Frequency Dial through a 24:1 gear train, providing a total of 2300 logging divisions for each RF range.

4. Fine Tuning Control.

This control permits continuous tuning over a range of approximately ± 10 kc on the 54 to 108 mc range, and ± 20 kc on the 108 to 216 mc range. No calibration is provided.

5. Incremental Frequency Switch.

The ΔF Switch permits tuning in increments of 0, ± 2.5, ± 5, ± 7.5; ± 10, ± 12.5, ± 15, ± 25, and ± 30 kc in the 54 to 108 mc range, and twice these values in the 108 to 216 mc range.

6. RF Monitor Meter.

The RF Monitor Meter is used to standardize the power level of the last r-f amplifier stage. In operation the meter pointer is set to the red calibration line on the meter scale.

7. RF Monitor Control.

This adjustment sets the RF Monitor Meter to the proper reference level such that the output attenuator calibration is direct reading in microvolts.

8. RF Output Attenuator.

The RF Output Attenuator Dial is calibrated directly in microvolts output at the output cable terminals. It is standardized by setting the pointer of the RF Monitor Meter to the red calibration mark on the meter scale.

9. Modulation Frequency Switch.

This control selects any one of eight fixed audio frequencies; from 50 cycles to 10 kilocycles for either frequency or amplitude modulation, and 60 kilocycles for calibration of the Incremental Frequency Switch.

10. Modulation Selector Switch.

Either frequency or amplitude modulation may be obtained by setting this switch to the proper position. Modulation may also be turned off.

11. FM Deviation Control.

A continuously variable control for adjusting the frequency deviation on any of the three ranges 0-24 kc, 0-80 kc, or 0-240 kc.

12. Amplitude Modulation Control.

A continuously variable control for adjusting the amplitude modulation level when either the internal AF oscillator or an external AF oscillator is used.

13. Modulation Meter.

Three Modulation Meter scales are provided; 0-24 kc deviation in 1 kc increments, 0-80 kc deviation in 5 kc increments, 0-240 kc deviation in 10 kc increments, 0-50% amplitude modulation, with calibration marks at 30% and 50%.

14. Modulation Meter Switch.

By means of this control the Modulation Meter may be switched to either the FM or AM modulating system to indicate the degree of modulation present.

15. Deviation Range Switch.

This rotary type switch selects three modulation meter deviation ranges, 0-24 kc, 0-80 kc, and 0-240 kc.

16. External Oscillator Binding Posts.

These posts provide a means whereby an external source of modulating voltage may be applied to the instrument.

The output voltage of the internal oscillator is available at the external binding posts for synchronizing or other purposes.

17. Pulse Modulation Jack.

The Pulse Modulation Jack is provided to permit direct connection of an external modulation voltage source to the screen of the final stage for pulse and square wave modulation. When this connection is made the modulation meter and internal circuits are disconnected from the screen element.

18. Calibrate ΔF Control.

This control is used in the calibration of the Incremental Frequency Switch and is accessible by removing the plug button from the generator front panel.

19. RF Output Jack.

This jack makes available for use the generator RF signal.

IV. THEORY OF OPERATION

REACTANCE MODULATION CIRCUIT

A 6AK5 tube (V5) operating as an inductive element across the tank circuit of the 6C4 (V6) oscillator circuit is employed for reactance modulation. In order to maintain constant frequency deviation sensitivity over the entire tuning range of the instrument, the amount of inductance injected by V5 is made to vary directly as the carrier frequency. This is accomplished by a bridged tee network consisting of R43, R44, C33, the grid plate capacitance of V5, and the grid cathode capacitance of V5. Although this circuit

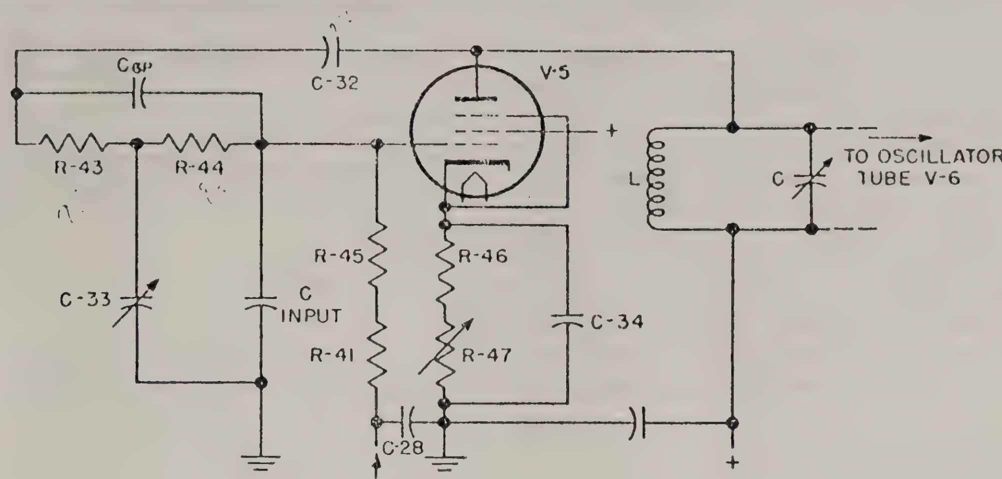


Fig. 4 Basic Reactance Modulator Circuit

arrangement is capable of producing fairly constant deviation with fixed components, C33 is made variable and ganged with the oscillator tuning condenser to provide the precision of deviation calibration required in a signal generator.

Resistor R50 serves to bleed the proper amount of current through R46, R47 to permit operation of V5 over the most linear portion of its characteristics (Fig. 8).

The cathode resistors R46 and R47 which provide bias for V5 are bypassed by C34 for radio frequencies only and degeneration takes place at audio frequencies. Resistor R47 is used to adjust the amount of degeneration present in order to provide the desired deviation sensitivity.

On the high RF range the modulation voltage for FM is reduced to one half in order to maintain the same frequency deviation (Fig. 14). This is accomplished by means of resistors R23, R26, and switch S3 (Fig. 14) which is mechanically coupled to the RF range changing switch. Switch S3 reduces the modulating voltage applied at the reactance tube to one third when operated from the 0-240 kc deviation position to the 0-80 kc deviation position, and to one tenth when operated from the 0-240 kc deviation position to the 0-24 kc deviation position.

For FM, an audio modulating voltage is applied directly to the grid of V5, the reactance tube, through an RF filter which prevents stray RF currents from leaking out of the shielded portion of the instrument.

RF OSCILLATOR (Fig. 14)

A tuned plate RF oscillator covers the frequency range from 27 to 54 mc. Tuning over this range is accomplished by means of capacitor C39 which is ganged to the two other variable tuning capacitors C45 and C50. The plate of V6 is normally operated at about 150 volts DC.

AMPLIFIER DOUBLER STAGE (Fig. 14)

A frequency doubling stage (V7) follows the oscillator and serves the two-fold purpose of (1) permitting the oscillator to be operated at a lower frequency and (2) providing the desired isolation between oscillator and output stage to improve frequency stability. A further advantage is that it provides sufficient drive to saturate the output stage and thus remove any spurious amplitude modulation up to this point. This stage is self-biased and is arranged to track with the oscillator.

OUTPUT STAGE (Fig. 14)

The output stage employs a 6AK5 tube operating in Class C. For the low RF range, this stage functions as an amplifier, and over the high range becomes a frequency doubler. The output tank coil is provided with two contact points located so that when the ground contact is switched from the lower to the upper point, the inductance of the tank coil is changed to double the resonant frequency of the tank circuit. Switching is accomplished by two spring contact fingers, one or the other of which is pressed against a contact point by insulated members on the shaft of the RF RANGE SWITCH. This method avoids most of the mechanical and electrical difficulties usually associated with coil switching. The Q of the tank circuit has been selected to reduce spurious signals by more than 35 db and at the same time keep amplitude modulation to about 2% at 75 kc deviation.

Amplitude modulation is obtained by modulating the screen element of V8, sufficient isolation from the DC supply having been provided by the 50-henry choke, L2.

OUTPUT ATTENUATOR

A piston type RF output attenuator having an internal impedance of 50 ohms is inductively coupled to the tank circuit inductor of the final stage. The pickup loop of the attenuator is continuously adjustable along the axis of the attenuator tube by means of a rack and

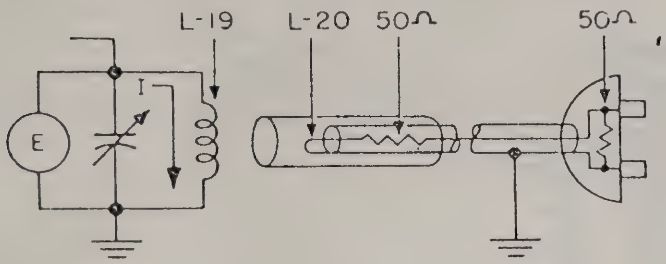


FIG. 5a

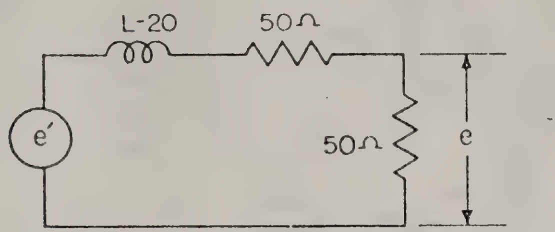


FIG. 5b

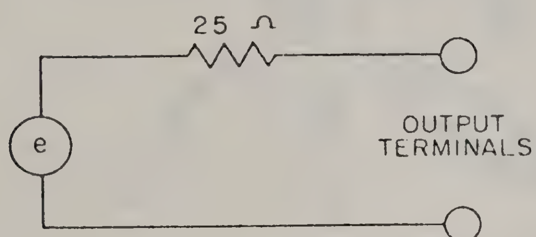


FIG. 5c

Fig. 5 Output Attenuator Equivalent Circuit

pinion drive.

The RG58A/U output cable and BNC panel fittings are of 50 ohm impedance and the output cable is terminated by a 50 ohm carbon film resistor.

Figure 4 shows the basic design of the output attenuator system. The voltage induced in the attenuator coupling loop L20 in figure 4a is:

$$e' = I\omega M = \frac{E}{\omega L_{19}} \times \omega K \sqrt{L_{19} L_{20}} = EK\sqrt{\frac{L_{20}}{L_{19}}}$$

where $\omega = 2\pi$ times the frequency, K is the coefficient of coupling between L_{19} and L_{20}, and M is the mutual inductance between L_{19} and L_{20}.

This equation shows that e′ is a function of the tank voltage E and the coefficient of coupling K only. K is controlled by the attenuation law of the piston attenuator while E is monitored by the output monitor meter.

It can be seen from figure 4b that the voltage e across the terminating resistor is:

$$e = \frac{50\ e'}{100 + j\ (\omega L_{20})} = \frac{50\ e'}{\sqrt{(100)^2 + (\omega L_{20})^2}}$$

Since L_{20} is less than 0.01 microhenry, $(\omega L_{20})^2$ can be neglected in comparison with $(100)^2$ and:

$$e = \frac{e'}{2}$$

Neglecting L_{20} in figure 5b, an application of Thevenin's theorem yields the equivalent circuit shown in figure 4c. Thus the generator can be represented as a source voltage e in series with a resistance of 25 ohms. The attenuator dial is calibrated in terms of the open circuit output voltage e (Fig. 5c) and is direct reading in microvolts from 0.1 microvolt to 0.2 volt when the output monitor meter is set to the red reference line.

If the load impedance is not large compared with ohms, the voltage applied to a load connected at the output terminals can be calculated by using the equivalent circuit of figure 5c.

AF OSCILLATOR (Fig. 14)

The AF oscillator employed is quite free from distortion having, in general, total harmonic content of less than 0.5%. The conventional Wein bridge type of R-C oscillator is used. The series and shunt R-C combinations required to provide the desired modulating frequencies are mounted directly on the rotary type selector switch and are connected by means of two leads to the AF chassis which mounts the oscillator tubes and components. Approximately 50 volts is available from the plate of the 6V6 tube (V2) for modulating purposes, the exact value being controlled by adjustment of R12 which regulates the amount of negative feedback voltage applied to the cathode of V1.

ELECTRONIC TUNING CIRCUITRY (Fig. 14)

The 0.1 mfd blocking condenser C-56 permits application of a DC bias to the reactance tube grid without interfering with frequency modulation by an audio signal. The low frequency half-power frequency is about 12 cps.

Biasing voltage is provided by a No. 1 flashlight cell. Because the battery current drain is only 5 microamperes, its life is practically "shelf life." However, the battery should be replaced every six months to prevent development of noise due to chemical deterioration. The battery is readily accessible by removing the back cover of the generator cabinet.

PULSE MODULATION (Fig. 14)

Pulse Modulation Jack J-1 provides a means for introducing an external voltage source to pulse or square wave modulate the r-f carrier. When this connection is made the modulation meter and internal circuits are disconnected from the screen. Resistor R-96 is in series with the screen lead to damp out any transients which might otherwise occur.

POWER SUPPLY (Fig. 14)

The high voltage supply provides +265 V unregulated and +150 V regulated by a VR-150 voltage regulator tube. Resistor R19 is adjusted at the factory to keep the current through the regulator tube within the limits of 5 to 40 milli-amperes when the line voltage is varied from 105 to 125 volts and with the signal generator adjusted for normal operation.

The DC filament voltage is provided by a circuit

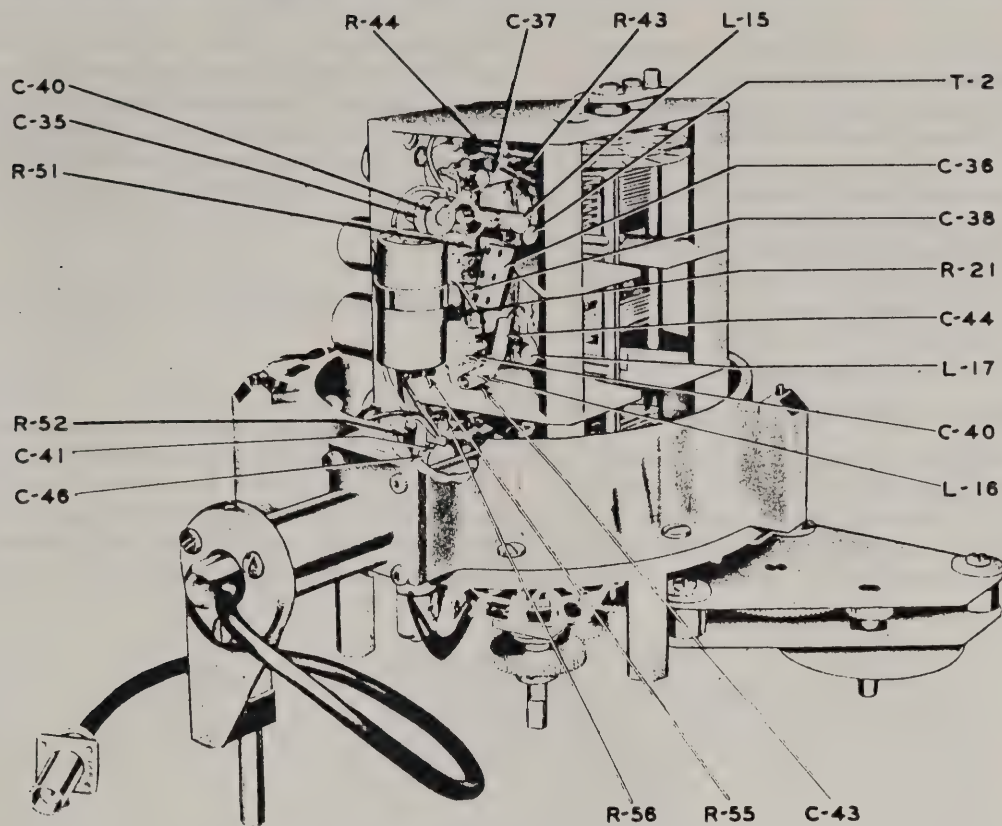


Fig. 6 RF Unit, Left Oblique, Cover Removed

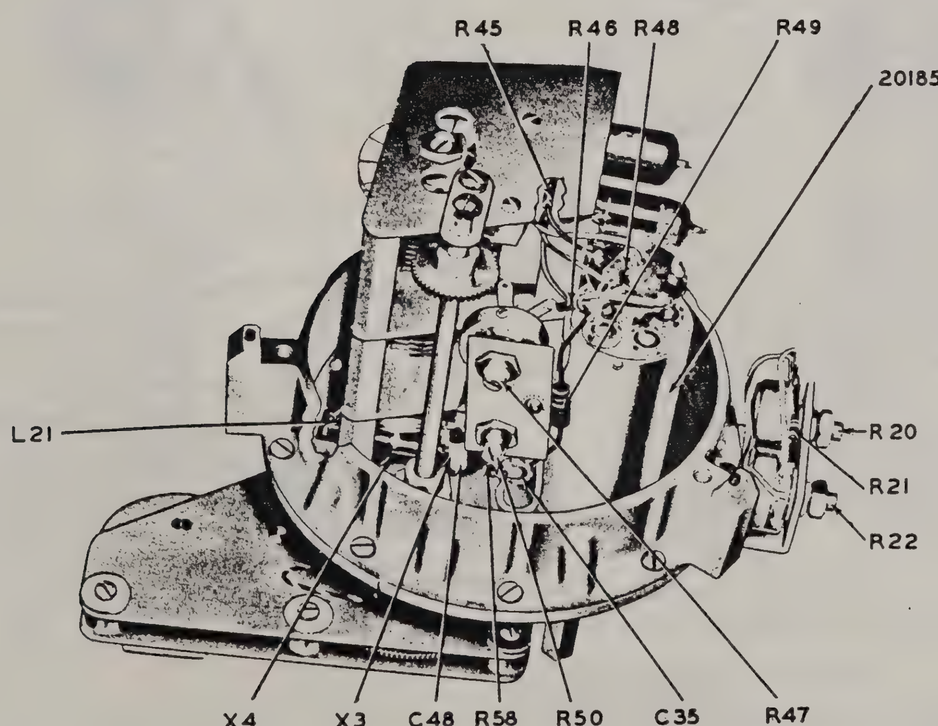


Fig. 7 RF Unit, Right Oblique, Cover Removed

composed of a transformer, bridge type selenium rectifier, choke, and filter condenser. Resistor R66 in the primary of the filament transformer is adjusted at the factory to provide a filament voltage of 6.9 volts at the power cable terminals on the terminal board mounted on the back of the generator front panel.

V. MAINTENANCE INSTRUCTIONS

RF UNIT (Fig. 6)

This unit has been carefully adjusted and calibrated at the factory to meet the specifications listed in this instruction book. Specialized testing equipment and procedures are required which make field adjustments and replacements in the unit difficult and undesirable. For this reason, if any troubles are believed to have developed in the RF Unit, the Signal Generator should be returned to the factory for repair and readjustment, with the factory warranty being voided if our inspection shows damage or misalignment due to adjustments made by the customer.

The DC heater voltage between pin D of plug P-2 and ground (Fig. 6) should measure 6.8 volts. If the RF unit is found to be inoperable and this voltage measures in excess of 7 volts, the trouble is probably due to an open heater circuit at one of the RF tubes. Continued operation of the instrument under this condition will damage the other RF tubes.

AMPLITUDE MODULATION ADJUSTMENT

If desired, the degree of amplitude modulation on the modulation meter can be checked by suitably mixing the output of the generator with another signal source such that a difference frequency of approximately 100-150 kc is produced. This difference fre-

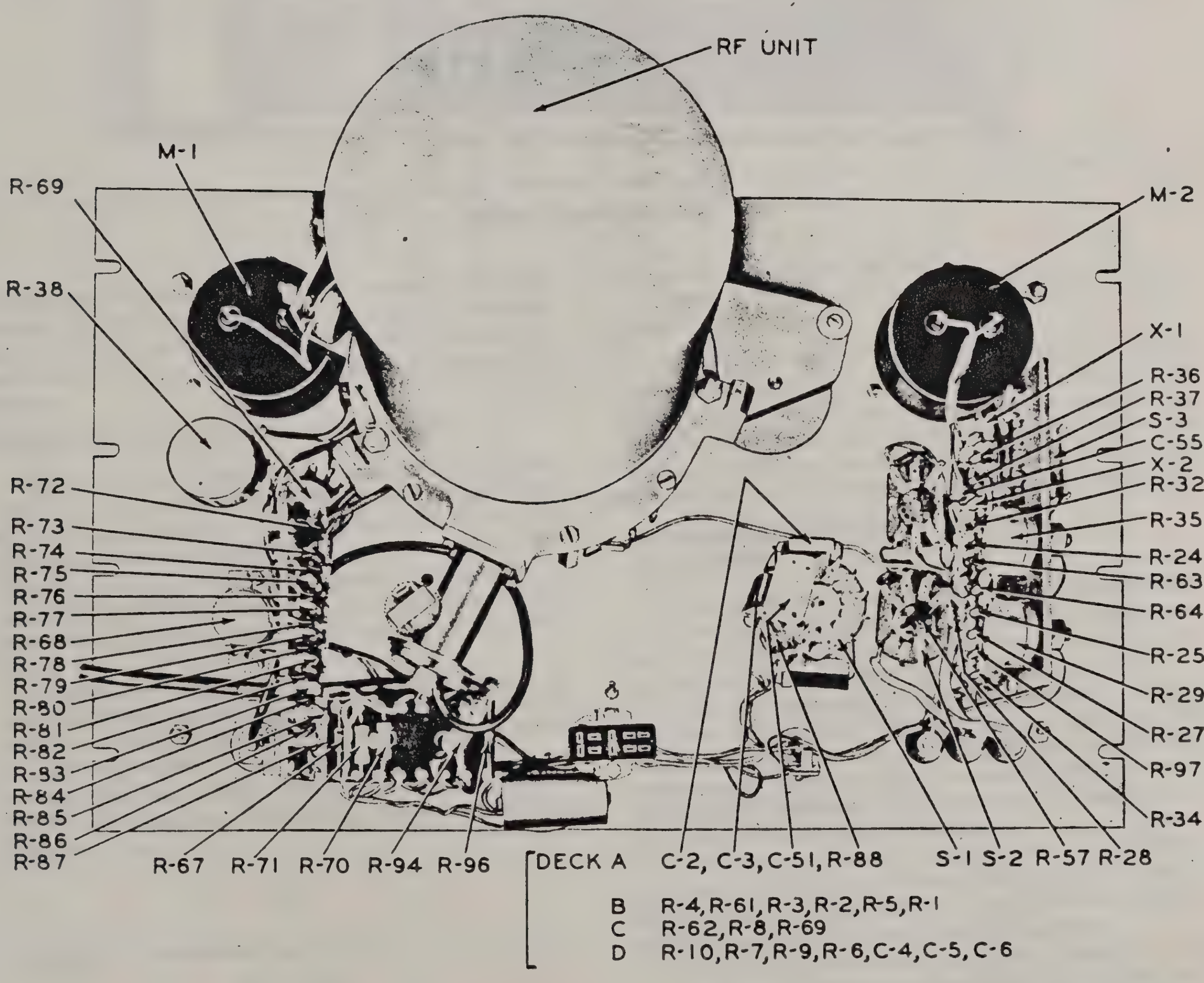


Fig. 8 Control Panel Assembly, Rear View

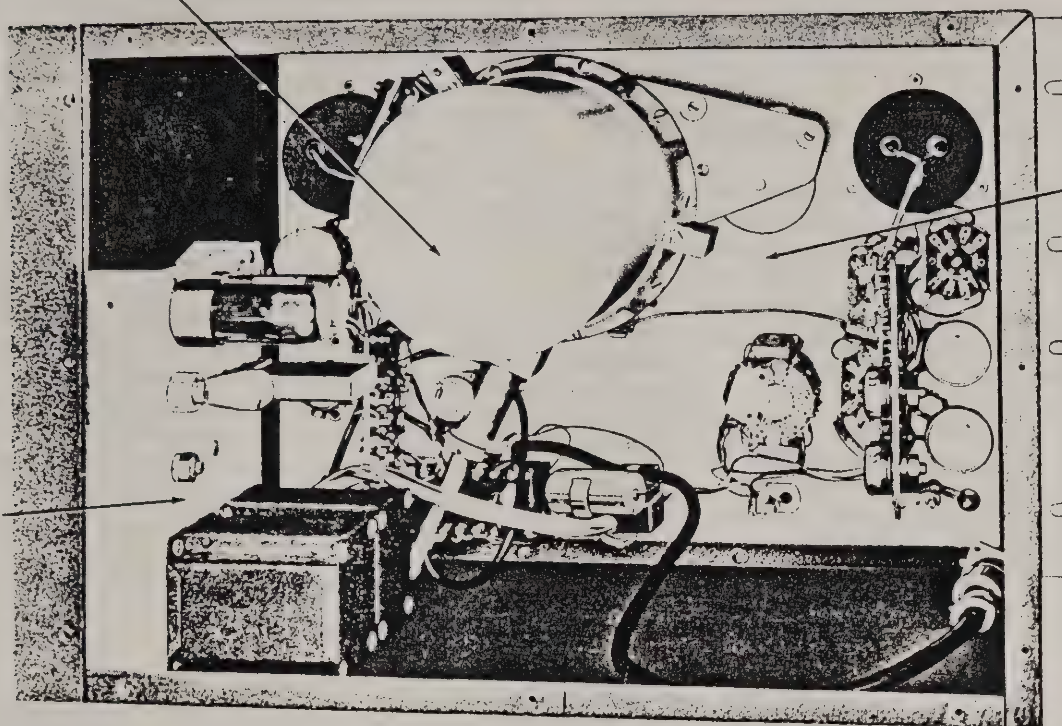


Fig. 9 RF Generator Chassis Assembly, Rear View

quency can be observed visually on a cathode ray oscilloscope and used for adjustment purposes. Adjustment of R35 (Fig. 6) will change the modulation meter AM sensitivity to agree with that degree of modulation present.

FREQUENCY MODULATION ADJUSTMENT

The 6AK5 reactance modulator tube contained within the sealed RF unit has been carefully adjusted for a deviation sensitivity of 50 kc per volt on the low RF range, with the deviation range switch set at the 0-240 kc position. If for any reason it is desired to check the carrier deviation, this may be accomplished using the Crosby* or carrier zero method of measurement.

A selective communications superheterodyne receiver tuned to the RF output of the generator can be used as a null indicator to determine the exact point at which the carrier current disappears.

Since the modulation index B is defined as the ratio of the frequency deviation ΔF to the modulating frequency f, or

$$B = \frac{\Delta F}{f}$$

the frequency deviation is given by:

$$\Delta F = B \times f$$

The carrier will reach its minimum value at the following modulation indices:

2.404; 5.5201; 8.653; 11.791; 14.930; 18.071; 21.2116, etc.

The FM deviation indicated on the modulation meter is controlled by the setting of R29 (Fig. 14). A slight adjustment of this control may be made if desired; however the actual deviation sensitivity of the reactance modulator is adjusted by means of R47 (Fig. 14) within the RF shield, and should not be disturbed.

INCREMENTAL FREQUENCY SWITCH CALIBRATION

The incremental Frequency Switch can be calibrated with the aid of a narrow band frequency modulation receiver (which operates in the frequency range of 108 to 216 mc) equipped with a tuning meter.

1. Set the Incremental Frequency Switch at "0" and the Fine Tuning control at mid-rotation. Apply a 1,000 microvolt signal to the antenna connection of the receiver and carefully tune the signal generator with the Vernier Frequency Control until the receiver tuning meter indicates perfect tuning.

2. Adjust the signal generator for a frequency modulation deviation of about 10 kc at a 60 kc modulation frequency. This will produce side bands spaced 60 kc above and below the carrier frequency.

3. Turn the Incremental Frequency Switch to + 60 kc. The lower side band should now fall in the passband of the receiver. If the tuning meter does not

indicate perfect tuning, adjust the calib. ΔF potentiometer on the generator front panel. Recheck the tuning of the carrier with the Incremental Frequency Switch at "0" and repeat the procedure if necessary.

4. The Incremental Frequency Switch can also be calibrated with the aid of a communications type receiver equipped with a beat frequency oscillator. The method will be apparent from the description given above.

VR-150 REGULATOR TUBE (Fig. 12)

When replacing this tube (V4) it is desirable to check its current drain by placing a milliameter in series with the plate and adjusting R19 for a 7 milliampere plate current with the input voltage to the power transformer primary set at 105 volts. The adjustment will insure proper operation of the power supply over a line voltage range of 105-125 volts.

BATTERY, NO. 1 CELL

It is recommended that the battery be replaced every six months. It is accessible by removing the back cover of the generator cabinet.

VI. TROUBLE-SHOOTING

Many cases of non-operation or malfunctioning are the result of tube failure. A visual inspection will often show a tube inoperative, and its replacement will restore normal performance.

If all the tubes light, but performance is abnormal, the tubes should be checked in a tube tester, and returned, if good, to the sockets from which they were removed.

To facilitate the detection and localization of possible trouble, two charts are presented in the following pages. The first, a "Trouble Chart", lists by symptoms some known trouble conditions and their remedies. The second "Socket Voltage Chart", gives average operating potentials under the stated conditions.

TROUBLE CHART

Symptom	*Probable Cause*	*Remedy*
With Equipment Connected to a suitable 115-Volt Source and Power Switch "ON", Panel lamp does not light.	Fuse Defective.	Replace fuse with 2A. Littlefuse No. 3AG-2.
	Panel Lamp Open.	Replace Panel Lamp.
	Primary winding or lamp secondary winding of Power transformer open.	Check continuity of Transformer and replace if found defective.
Not all vacuum tube filaments light.	Defective Vacuum tube.	Test for defective tube using tube tester.
	Filament Ballast R-90 open.	Replace R-90 with 6H-6 Ballast tube.
No vacuum tube filaments light.	Primary or secondary winding of Filament Transformer open.	Check continuity of Transformer and replace if found defective.
	Selenium Rectifier defective.	Replace X-5.
	C-52 defective.	Check and replace if found defective.
	L-22 open.	Check continuity of choke and replace if found defective.
Fuse blows repeatedly as soon as power is applied, or blows sometime after power is applied.	V-3, C-12, C-13, C-14, Power Transformer, or Filament Transformer defective.	Remove V-3. If fuse does not blow with V-3 removed, check C-12, C-13, C-14 for possible short. If normal, test V-3 in tube tester.
Filaments light but no Plate Voltages.	V-3 defective.	Replace V-3.
	L-3 or L-4 open.	Check continuity of L-3 and L-4.
	C-12, C-13, or C-14 shorted.	Check respective parts replacing any part found defective.

TROUBLE CHART cont.

Symptom	*Probable Cause*	*Remedy*
	Defective connection to terminal B of Plug P-2.	Check Terminal connections and wiring continuity of Plug P-2.
RF Unit Inoperative.	R-17 defective.	Check R-17 and replace if found defective.
	C-12 shorted.	Check C-12 and replace if found defective.
	Defective connection to terminal E of Plug P-2.	Check terminal connections and wiring continuity.
	*Plug P-1 from Audio Oscillator not plugged into Front Panel Socket.	Connect Plug P-1 to Front Panel socket.

**NOTE:* *No RF output will be obtained with the audio oscillator plug P detached from the front panel assembly since the DC screen supply for the final amplifier double tube, V8, is wired from the power supply through the audio unit and thence to the RF panel.*

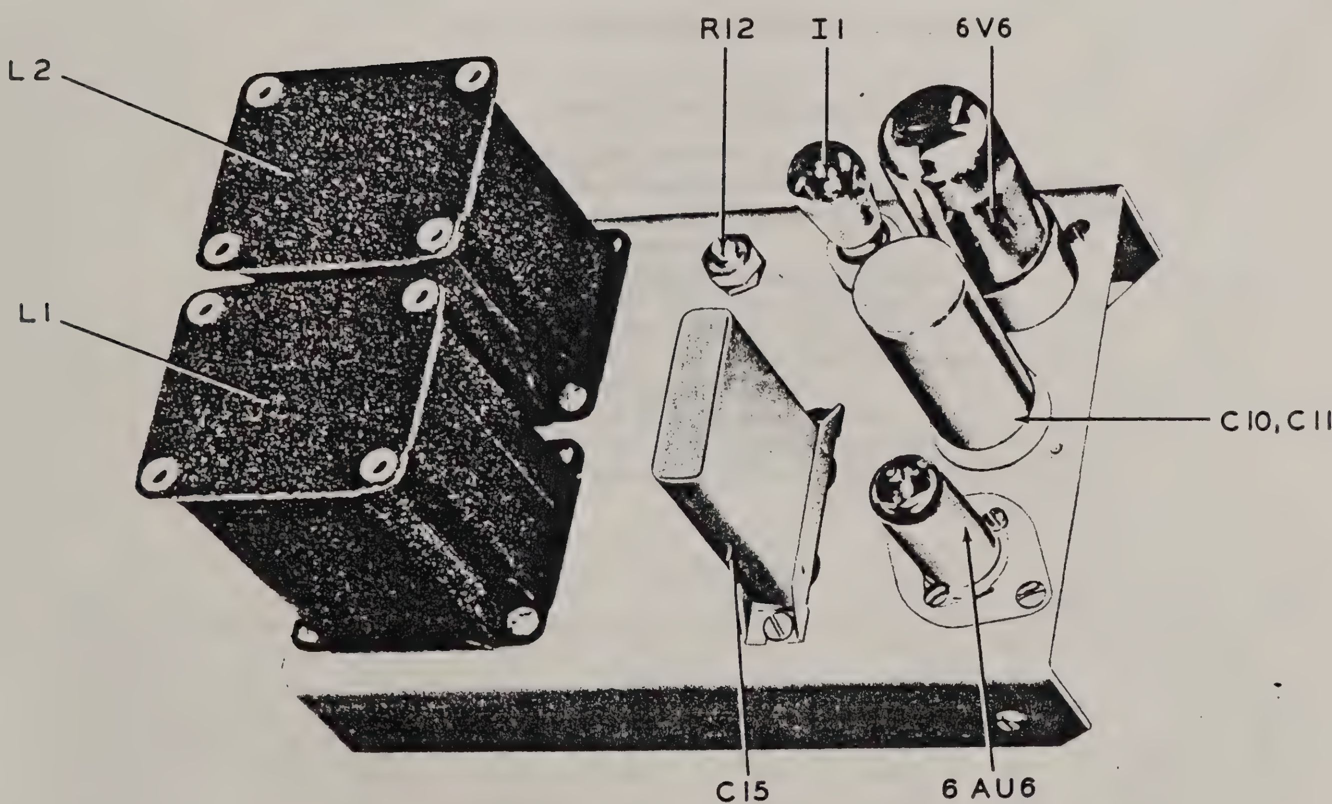


Fig. 10 Audio Oscillator Assembly, Top View

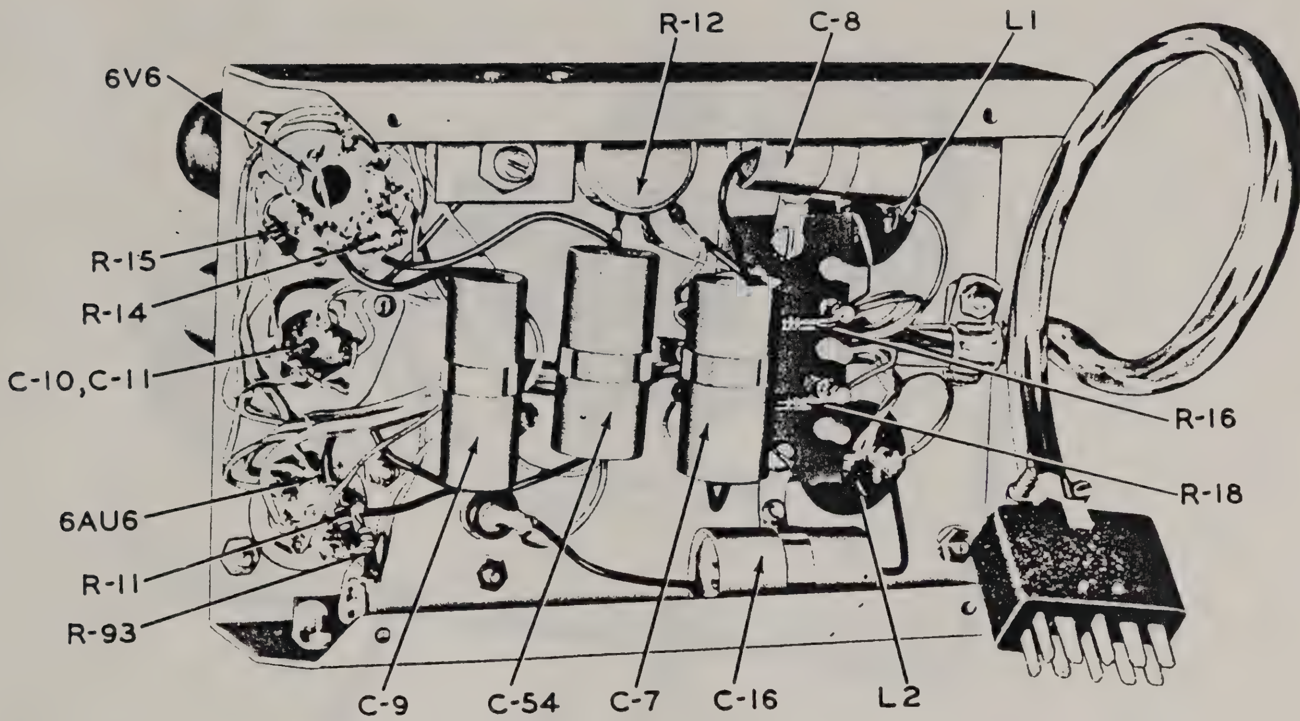


Fig. 11 Audio Oscillator Assembly, Bottom View

SOCKET VOLTAGE CHART

All voltages are DC unless otherwise indicated.
All DC measurements are made with 20,000 ohms per volt voltmeter.
All AC measurements are made with 1000 ohms per volt AC voltmeter.

Conditions for measurements:

a. Measurements made with respect to ground.
b. RF RANGE SWITCH set at 108-216 mc position.
c. FREQUENCY MC DIAL set at 216 mc.
d. ATTENUATOR DIAL set at 100K Microvolt.
e. MODULATION SWITCH off.
f. RF MONITOR METER set at red line.
g. MODULATION METER SWITCH at FM.
h. MODULATION FREQUENCY SWITCH at 400 cps.

	Pin Numbers							
Tubes	1	2	3	4	5	6	7	8
V-1 (6AU6)	0	2.4	0	6.3	150	85	2.4	
V-2 (6V6)	0	6.3	220	0	0	0	0	5.2
V-3 (5Y3)	0	290	0	400 A.C.	0	400 A.C.	0	290
V-4 (VR-150)	0	0	0	0	150	0	0	0
R-18 (6H-6)	0	6.7	0	0	6.3	0	14.2	0
V-5 (6AK5)	0	4.2	6.2	0	130	130	4.2	
V-6 (6C4)	130	0	6.2	0	130	1.5	0	
V-7 (6AK5)	0.25	0	6.2	0	134	135	0	
V-8 (6AK5)	0.6	0	6.2	0	140	103	0	

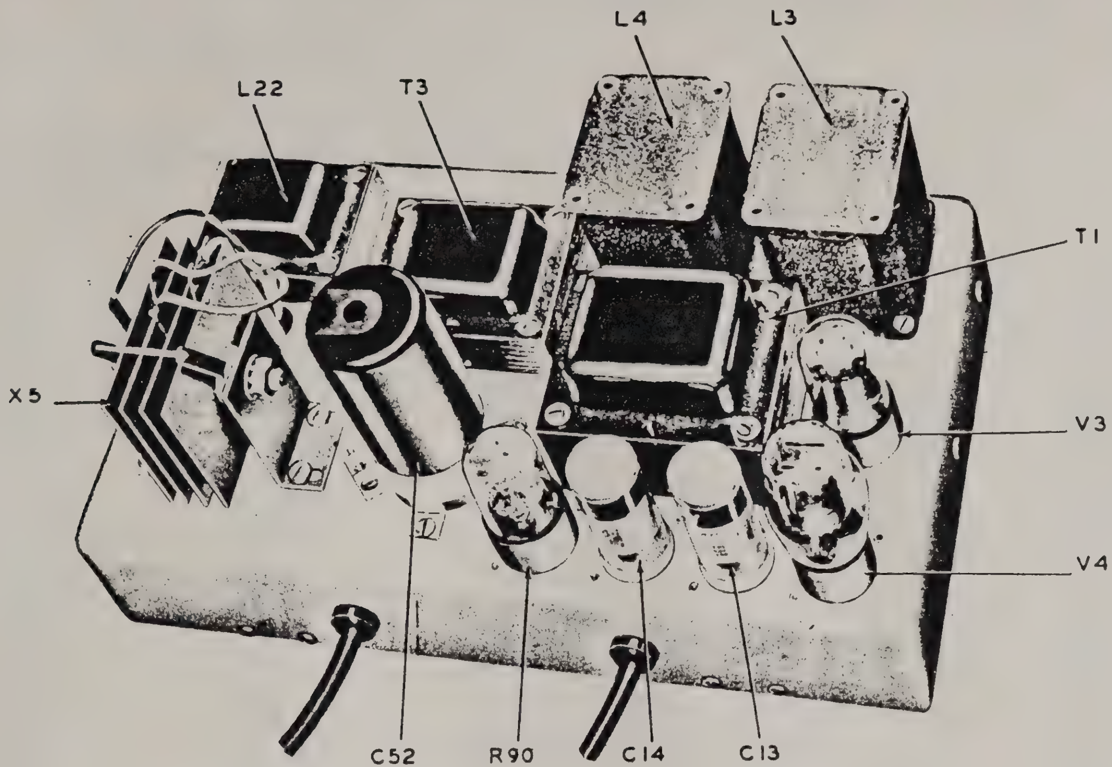


Fig. 12 Power Supply, Top View

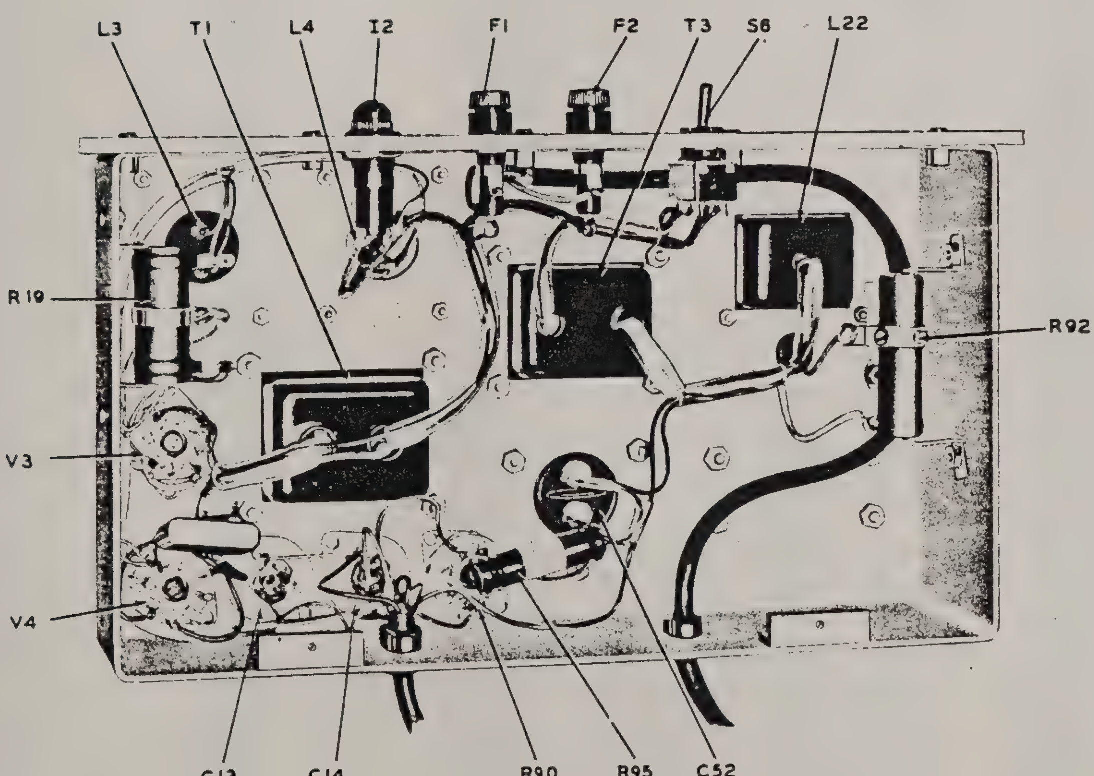


Fig. 13 Power Supply, Bottom View

VII. LIST OF REPLACEABLE PARTS

The following parts are replaceable. After replacement it is desirable to make the checks and adjustments described in Section V.

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST

Circuit Symbol	Value	Description	BRC Part No.
R-1,6	332KΩ	Resistor, Fixed ±1% 1/2W Carbon	80630
R-2,7	166KΩ	Resistor, Fixed ±1% 1/2W Carbon	80567
R-3,8	40.2KΩ	Resistor, Fixed ±1% 1/2W Carbon	80492
R-4,9	31.2KΩ	Resistor, Fixed±1% 1/2W Carbon	80491
R-5,10	20.8KΩ	Resistor, Fixed ±1% 1/2W Carbon	80490
R-11,21,67	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-12,29,35	10KΩ	Resistor, Var. ±10% 2W	81314
R-13,16	33KΩ	Resistor, Fixed±5% 1/2W Carbon	80461
R-14	220KΩ	Resistor, Fixed ±5% 1/2W Carbon	80555
R-15	150Ω	Resistor, Fixed ±5% 1/2W Carbon	80098
R-17	100Ω	Resistor, Fixed ±5% 1/2W Carbon	80062
R-20	250KΩ	Resistor, Var. ±10% 2W	81601
R-21	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-22	100KΩ	Resistor, Var. ±10% 2W	81507
R-19	2.5KΩ	Resistor, Adjustable ±5% 25W	80268
R-23,26	2KΩ	Resistor, Fixed ±1/2% 1/2W Carbon	80216
R-24	9.1KΩ	Resistor. Fixed ±5% 1/2W Carbon	80327
R-25,27	4KΩ	Resistor, Fixed ±1/2% 1/2W Carbon	80247
R-28	1950Ω	Resistor, Fixed ±1/2% 1/2W Carbon	80206
R-30	6.8KΩ	Resistor, Fixed ±5% 1/2W Carbon	80387
R-31	3KΩ	Resistor, Var. ±5% 3W	81210
R-32,34	22KΩ	Resistor, Fixed ±5% 1/2W Carbon	80472
R-33	25KΩ	Resistor, Var. ±10% 3W	81411
R-36,37	33KΩ	Resistor, Fixed ±2%, 1/2W Carbon	80486
R-38	15KΩ	Resistor, Var. ±5% 3W	81331
R-43	2.2KΩ	Resistor, Fixed ±2% 1/2W Carbon	80269
R-44	820Ω	Resistor, Fixed ±2% 1/2W Carbon	80183
R-45	4.7KΩ	Resistor, Fixed ±5% 1/2W Carbon	80304
R-46	330Ω	Resistor, Fixed ±5% 1/2W Carbon	80172
R-47	500Ω	Resistor, Var. ±10% 2W	81128
R-48	68KΩ	Resistor, Fixed ±5% 1/2W Carbon	80552
R-49	27KΩ	Resistor, Fixed ±5% 1/2W Carbon	80487
R-50	250KΩ	Resistor, Var. ±20% 2W	81608
R-51	47KΩ	Resistor, Fixed ±5%1/2W Carbon	80460
R-52	1KΩ	Resistor, Fixed ±5% 1/2W Carbon	80148
R-53	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-54	15KΩ	Resistor, Fixed ±5% 1/2W Carbon	85572
R-55	1KΩ	Resistor, Fixed ±5% 1/2W Carbon	80148
R-56	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-57	10KΩ	Resistor, Fixed ±5% 1/2W Carbon	80361
R-58	51KΩ	Resistor, Fixed ±5% 1/2W Carbon	80437
R-59	50Ω	Resistor, Fixed ±1% 1/4W Film	80048
R-60	1000Ω	Resistor, Fixed ±5% 1/2W Carbon	85585
R-61,62	156KΩ	Resistor, Fixed ±1% 1/2W Carbon	80566
R-63	8.2KΩ	Resistor, Fixed ±5% 1/2W Carbon	80326

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST - *Continued*

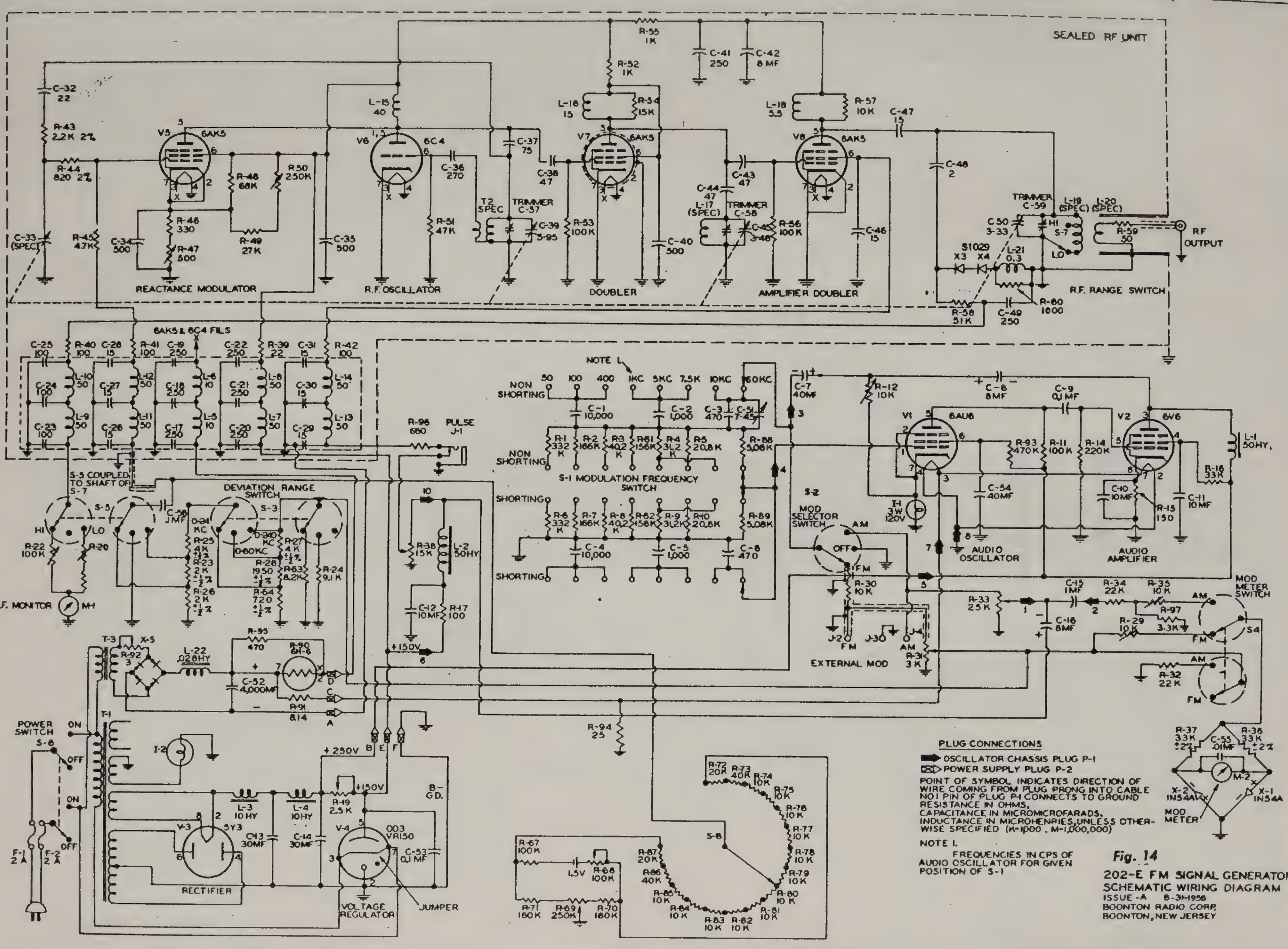
Circuit Symbol	Value	Description	BRC Part No.
R-64	720 Ω	Resistor, Fixed ±1/2% 1/2W Carbon	80147
R-68	100KΩ	Resistor, Var. ±10% 2W	81507
R-69	250KΩ	Resistor, Var. ±10% 2W	81616
R-70, 71	180KΩ	Resistor, Fixed ±1% 1/2W Carbon	80534
R-72, 87	20KΩ	Resistor, Fixed ±1% 1/2W Carbon	80344
R-73, 86	40KΩ	Resistor, Fixed ±1% 1/2W Carbon	80426
R-74--85	10KΩ	Resistor, Fixed ±1% 1/2W Carbon	80330
R-88, 89	5.08KΩ	Resistor, Fixed ±1% 1/2W Carbon	80312
R-90		Resistor, Thermal	91019
R-91	8.14Ω	Resistor, Fixed ±1% 10W	80019
R-92	3Ω	Resistor, Adjustable ±5% 25W	80004
R-93	470KΩ	Resistor, Fixed ±5% 1/2W Carbon	80640
R-94	25Ω	Resistor, Fixed ±10% 4W Carbon	80727
R-95	470Ω	Resistor, Fixed ±5% 1/2W Carbon	80170
R-96	680Ω	Resistor, Fixed ±5% 1/2W Carbon	80138
R-97	3.3KΩ	Resistor, Fixed ±5% 1/2W Carbon	80253
C-1, 4	10,000μμf	Cap., Fixed ±2% 300V Mica	82413
C-2, 5	1000μμf	Cap., Fixed ±2% 500V Mica	82302
C-3, 6	470μμf	Cap., Fixed ±2% 500V Mica	82239
C-7, 54	40μf	Cap., Fixed 150V Electrolytic	83045
C-8, 16	8μf	Cap., Fixed 450V Electrolytic	83028
C-9	0.1μf	Cap., Fixed +20%-10% 400V Elec.	83070
C-10, 11, 12 13, 14	10-10-10μf	Cap., Fixed 400V Electrolytic	83050
C-15	1μf	Cap., Fixed +20%-10% 400V Elec	83066
C-17	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-18	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-19	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-20	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-21	250μμf	Cap., Fixed ±10% 500 V Sil Mica	82232
C-22	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-23	100μμf	Cap., Fixed ±10% 500V Sil Mica	82140
C-24	100μμf	Cap., Fixed ±10% 500V Sil Mica	82140
C-25	100μμf	Cap., Fixed ±10% 500V Sil Mica	82140
C-26	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-27	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-28	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-29	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-30	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-31	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-32	22μμf	Cap., Fixed, ±5% 500V Ceramic	82030
C-33	Special	Cap., Variable	20207
C-34	500μμf	Cap., Fixed ±10% 500V Sil Mica	82235
C-35	500μμf	Cap., Fixed ±10% 500V Sil Mica	82231
C-36	270μμf	Cap., Fixed ±5% 500V Mica	82237
C-37	75μμf	Cap., Fixed ±5% 500V Ceramic	82135
C-38, 43, 44	47μμf	Cap., Fixed ±5% 500V Ceramic	82132
C-39	5-95μμf	Cap., Variable Air Dielectric	20207
C-40	500μμf	Cap., Fixed ±10% 500VSil Mica	82235
C-41	250μμf	Cap., Fixed ±10% Sil Mica	82236

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST - Conti ued

Circuit Symbol	Value	Description	BRC Part No.
C-42	8μμf	Cap., Fixed 450V Electrolytic	83029
C-43	47μμf	Cap., Fixed ±5% 500V Ceramic	82132
C-44	47μμf	Cap., Fixed ±5% 500V Ceramic	82132
C-45	3-48μμf	Cap. Variable Air Dielectric	20207
C-46	15μμf	Cap., Fixed ±10% 500V Sil Mica	82014
C-47	15μμf	Cap., Fixed ±5% 500V Ceramic	82031
C-48	2μμf	Cap., Fixed ±5% 500V Ceramic	82136
C-49	250μμf	Cap., Fixed ±10% 500V Sil Mica	82230
C-50	3-33μμf	Cap., Variable Air Dielectric	20207
C-51	7-45μμf	Cap., Trimmer, Screw Type	84039
C-52	4000μf	Cap., Fixed 25V Electrolytic	83097
C-55	.01μf	Cap., Fixed 200V Paper	82402
C-57		Special	
C-58		Special	
C-59		Special	
L-1,2	50h	Choke, Filter	85433
L-3,4	10h	Choke, Filter	85535
L-5	10μh	Coil, Radio Frequency	85575
L-6	10μh	Coil, Radio Frequency	85575
L-7	50μh	Coil, Radio Frequency	85592
L-8	50μh	Coil, Radio Frequency	85592
L-9	50μh	Coil, Radio Frequency	85592
L-10	50μh	Coil, Radio Frequency	85592
L-11	50μh	Coil, Radio Frequency	85592
L-12	50μh	Coil, Radio Frequency	85592
L-13	50μh	Coil, Radio Frequency	85592
L-14	50μh	Coil, Radio Frequency	85592
L-15	40μh	Coil, Radio Frequency	85573
L-16	15μh	Coil, Radio Frequency	85572
L-17	Special	Coil, Radio Frequency	85582
L-18	5.5μh	Coil, Radio Frequency	85584
L-19	Special	Coil, Radio Frequency	85583
L-20	Special	Coil, Radio Frequency	80088
L-21	0.3μh	Coil, Radio Frequency	85585
L-22	0.028h	Choke, Filter	300109
B-1		Battery, No.1 Cell, 1.5V	86707
F-1,2		Fuse, 2A	93251
I-1		Lamp, Incandescent, 120V, 3W	90907
I-2		Lamp, Incandescent, 6.3V, 0.15A	90904
J-1		Jack, Midget	89039
J-2,4		Jack, Binding Post, Insulated	304312
J-3		Jack, Binding Post	304311
J-5		Jack, BNC	89065
P-1		Plug, 10 male contacts	303335
P-2		Plug, 7 female contacts	300113

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST - *Continued*

Circuit Symbol	Value	Description	BRC Part No.
S-1		Switch, Rotary, 4 pole, 8 position 4 section	88058
S-2, 3		Switch, Rotary, 2 pole, 3 position 1 section	88083
S-4		Switch, Rotary, 2 pole, 2 position 1 section	88060
S-6		Switch, Toggle, DPDT	88059
S-8		Switch, Rotary, pole, 17 position	88097
T-1		Transformer, Power, 117V, 50-60 cps	85074
T-3		Transformer, Filament, 117V to 24V	300107
V-1		Tube	6AU6
V-2		Tube	6V6
V-3		Tube	5Y3
V-4		Tube	OD3/VR-150
V-5		Tube (selected 6AK5)	543A
V-6		Tube (selected 6C4)	544A
V-7		Tube(selected 6AK5)	543B
V-8		Tube (selected 6AK5)	543A
X-1, 2	1N54A	Crystal Diode, Germanium	91091
X-3, 4	S1029	Crystal Diode, Germanium	91093
X-5		Rectifier, Selenium	302622
		RF Unit, Complete	20205
		Holder, Fuse, Extractor Post	93677
		Light, Indicator, Miniature Bayonet	303876
		Lampholder, Candelabra Base	89026
		Socket, 10 Female Contacts	Jones
		Socket, 7 Male Contacts	Amphenol
M-1		Meter, 100μa, special scale	92026
M-2		Meter, 100μa, special scale	92025



PLUG CONNECTIONS

➡ OSCILLATOR CHASSIS PLUG P-1

⊠▷ POWER SUPPLY PLUG P-2

POINT OF SYMBOL INDICATES DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE
NO1 PIN OF PLUG P-1 CONNECTS TO GROUND
RESISTANCE IN OHMS,
CAPACITANCE IN MICROMICROFARADS,
INDUCTANCE IN MICROHENRIES, UNLESS OTHERWISE SPECIFIED (K=1000, M=1,000,000)

NOTE 1.
FREQUENCIES IN CPS OF AUDIO OSCILLATOR FOR GIVEN POSITION OF S-1

Fig. 14

202-E FM SIGNAL GENERATOR
SCHEMATIC WIRING DIAGRAM
ISSUE-A 8-31-1956
BOONTON RADIO CORP.
BOONTON, NEW JERSEY

APPENDIX

LIST OF ILLUSTRATIONS

APPENDIX

OUTPUT CONNECTIONS

A. The method of connecting the load to the 202-E Signal Generator or to the 207-E Univerter must be considered to insure proper interpretation of results, and the following discussion is offered as an aid to the user.

It is convenient to represent a signal source in terms of its open circuit voltage and internal impedance.* Thus a signal source or an antenna can be represented as in Figure 1. For simplicity, only the case where source and load impedance are resistive will be considered.

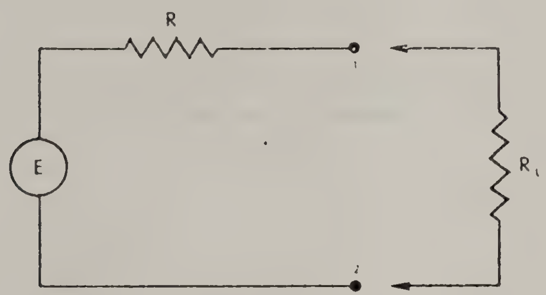


Fig. 1 Signal Source Representation

E — open circuit voltage
R — impedance looking into terminals 1 and 2
R_L — load impedance

For purposes of rating sensitivity, the input to a receiver might have been defined initially either as the open circuit source voltage E or the voltage actually across the receiver's terminals. The Institute of Radio Engineers has established the former method as standard and defined receiver input in terms of the open circuit voltage of the source.**

The impedance of the signal source employed to test receivers should be equal to the impedance of the antenna with which the receiver is designed to operate. Note that in this case the voltage actually across the receiver terminal is $\frac{E}{2}$ (Receiver input impedance equal to source impedance.)

*General Radio Experimenter, Vol. XXI, No. 1, June, 1946.

**The Institute of Radio Engineers, Section 4.01.01, 1947, Standards on Radio Receivers. The Institute of Radio Engineers, Section 4.01.01, 1948, Standards on Television.

B. *Accessories* for physically connecting the instrument to the load are described in the following:

1. *501-B Output Cable (supplied with 202-E)*

A 501-B Cable attached to the 202 or 207 is illustrated by Figure 2, where R_2 is the 50 ohm termination of the 501-B cable. The equivalent circuit (Figure 3) is readily determined by applying Thevinin's theorem. This arrangement is recommended for general use where it is desirable to connect the 202 or 207 output to an input circuit of relatively higher impedance than 25 ohms. The attenuator of the 202 will read the output directly.

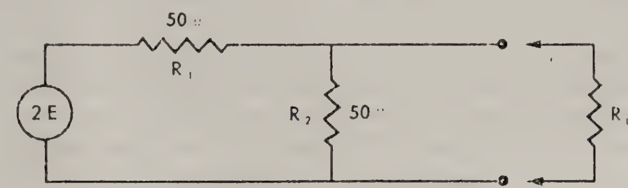


Fig. 2 Output Circuit of 202-E or 207-E with 501-B Output Cable Attached

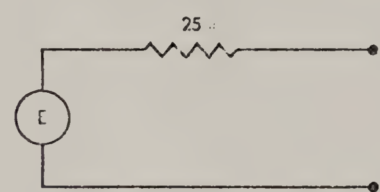


Fig. 3 Equivalent Output Circuit of 202-E or 207-E with 501-B Output Cable Attached

E — 202 attenuator dial reading
R_1 — internal resistance of 202 or 207
R_2 — 501-B cable termination
R_L — load impedance

2. *505-B, 6db Pad*

This pad is used as a dummy antenna in testing unbalanced receivers with a 50-ohm input as shown in Figure 4.

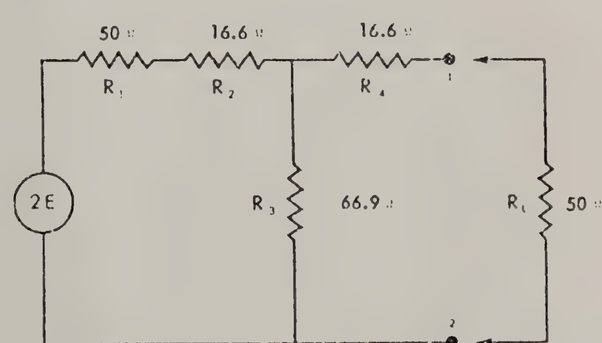


Fig. 4 505-B T-Pad as Dummy Antenna for Receiver

E — 202 attenuator dial reading
R_1 — internal resistance of 202 or 207
R_2 — pad resistance

R_3 — pad resistance
R_1 — pad resistance
R_L — load impedance

The open circuit voltage appearing across terminals 1 and 2 is by Ohms law (equation 1) equal to E, half of the source voltage. Applying Thevinin's theorem the equivalent circuit of Figure 5 is obtained, and thus the attenuator dial of the 202 reads receiver sensitivity directly for the assumed standard output.

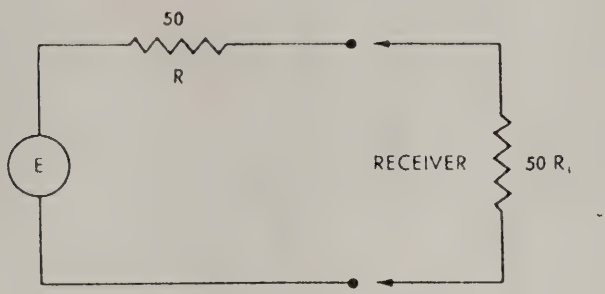


Fig. 5 Equivalent Circuit of a 505-B T-Pad as an Antenna

3. *509-B 20 db T-Pad (Supplied with the 207-E)*

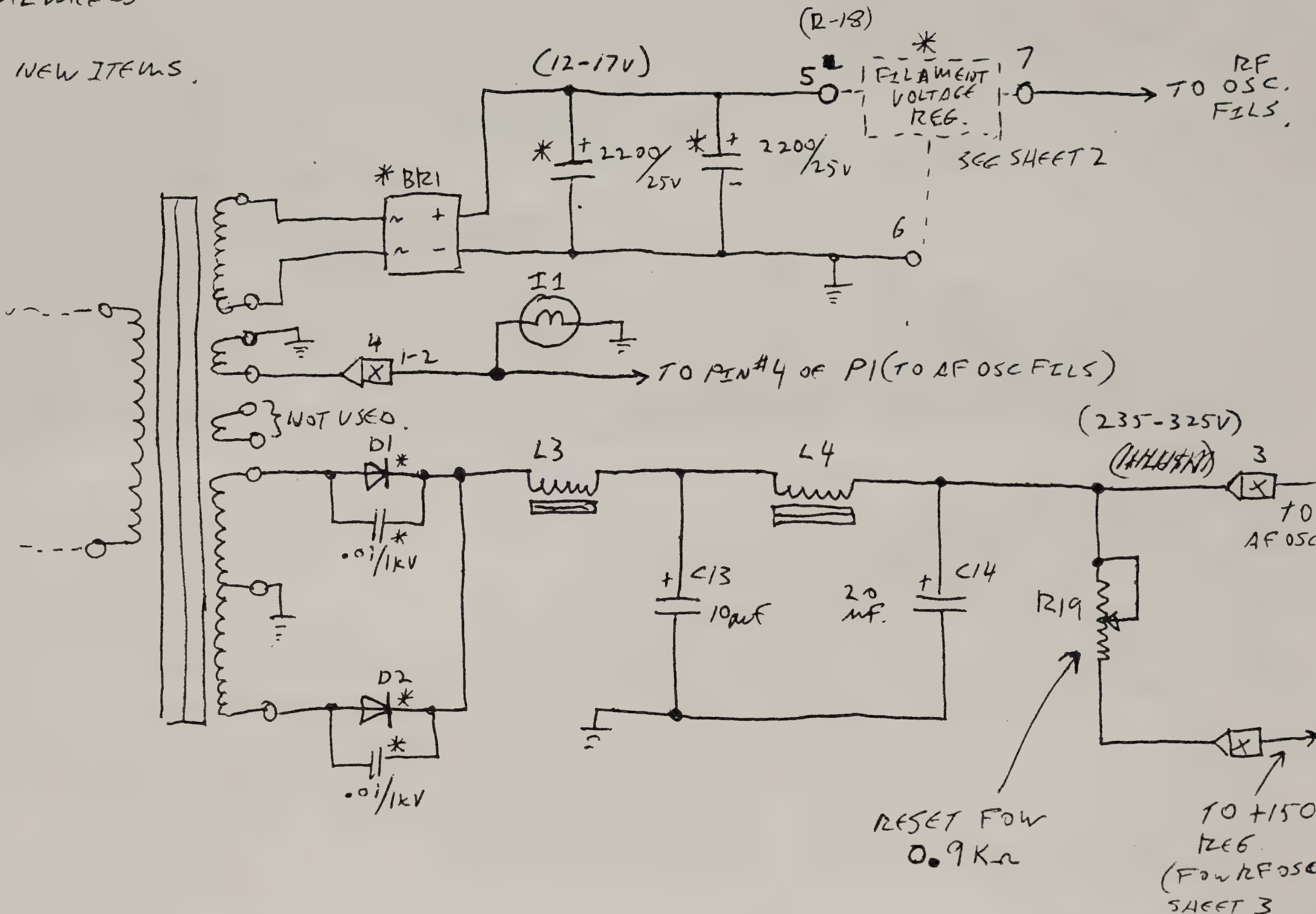
This pad is useful where signal levels are required which are low compared to the constant noise level of the 207. Since the noise level of the 207 is constant, the signal to noise ratio varies directly as the signal level. Therefore, with low output voltage the signal to noise ratio may be improved by increasing the input voltage and attenuating the output. For practical purposes the 20 db pad is useful at output levels below 500 microvolts for the 202-E. The signal applied to a 50-ohm load may be found by dividing the 202 attenuator dial reading by ten.

The 509-B pad, like the 505-B, may be used as a dummy antenna except that the measure of receiver sensitivity (equivalent source voltage) is one-fifth the 202 attenuator dial reading.

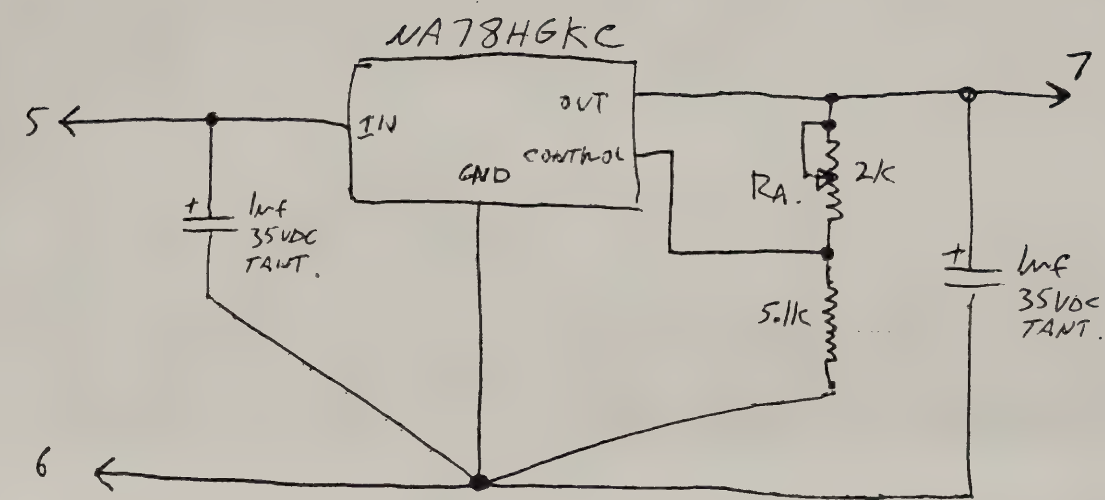
BOONTON 202-B

PWRSUPPLY MOD.
SHEET 1 OF 3
18 FEB 84 MLWEELS

* INDICATES NEW ITEMS.



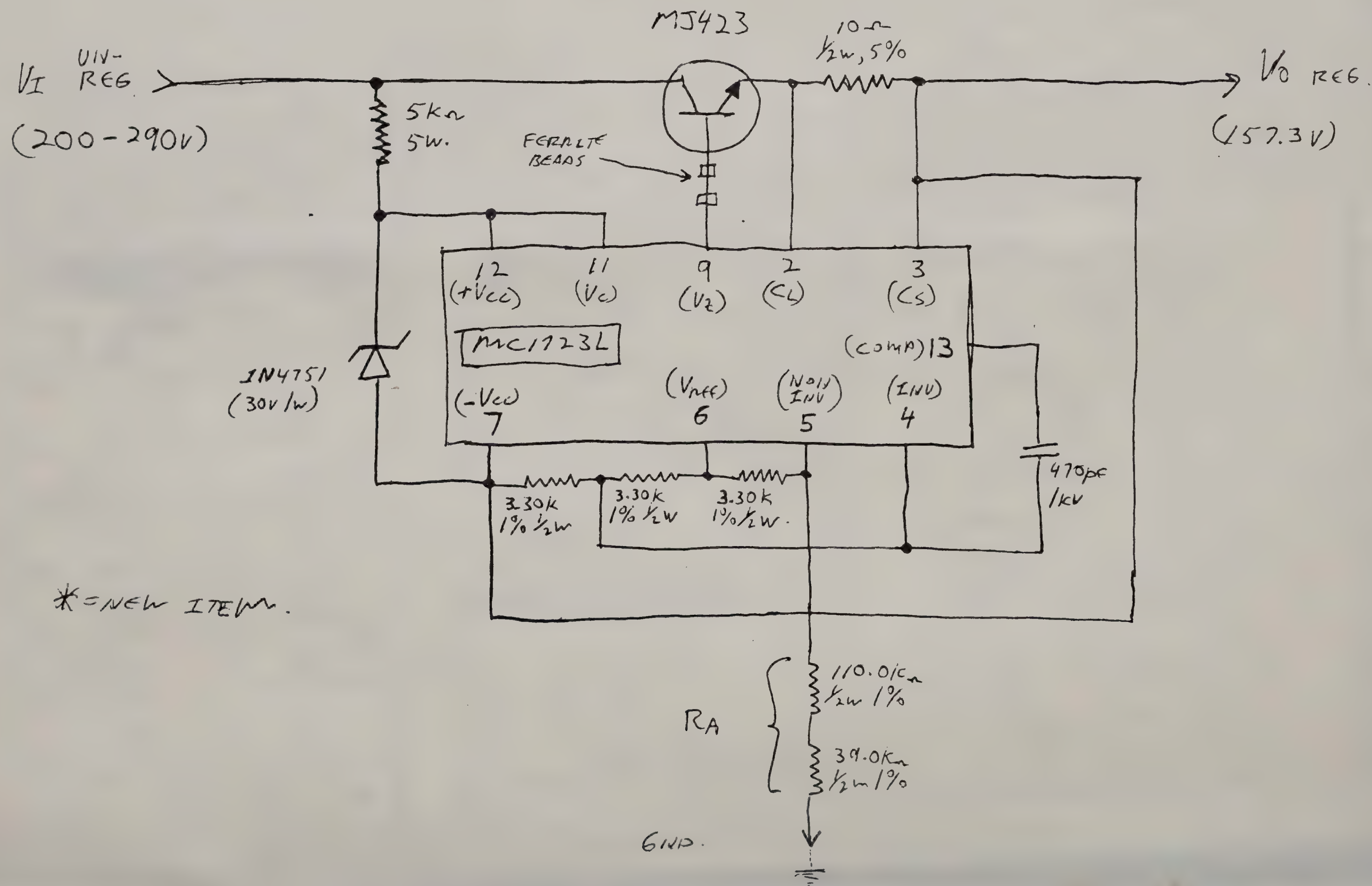
* FILAMENT VOLTAGE REGULATOR.



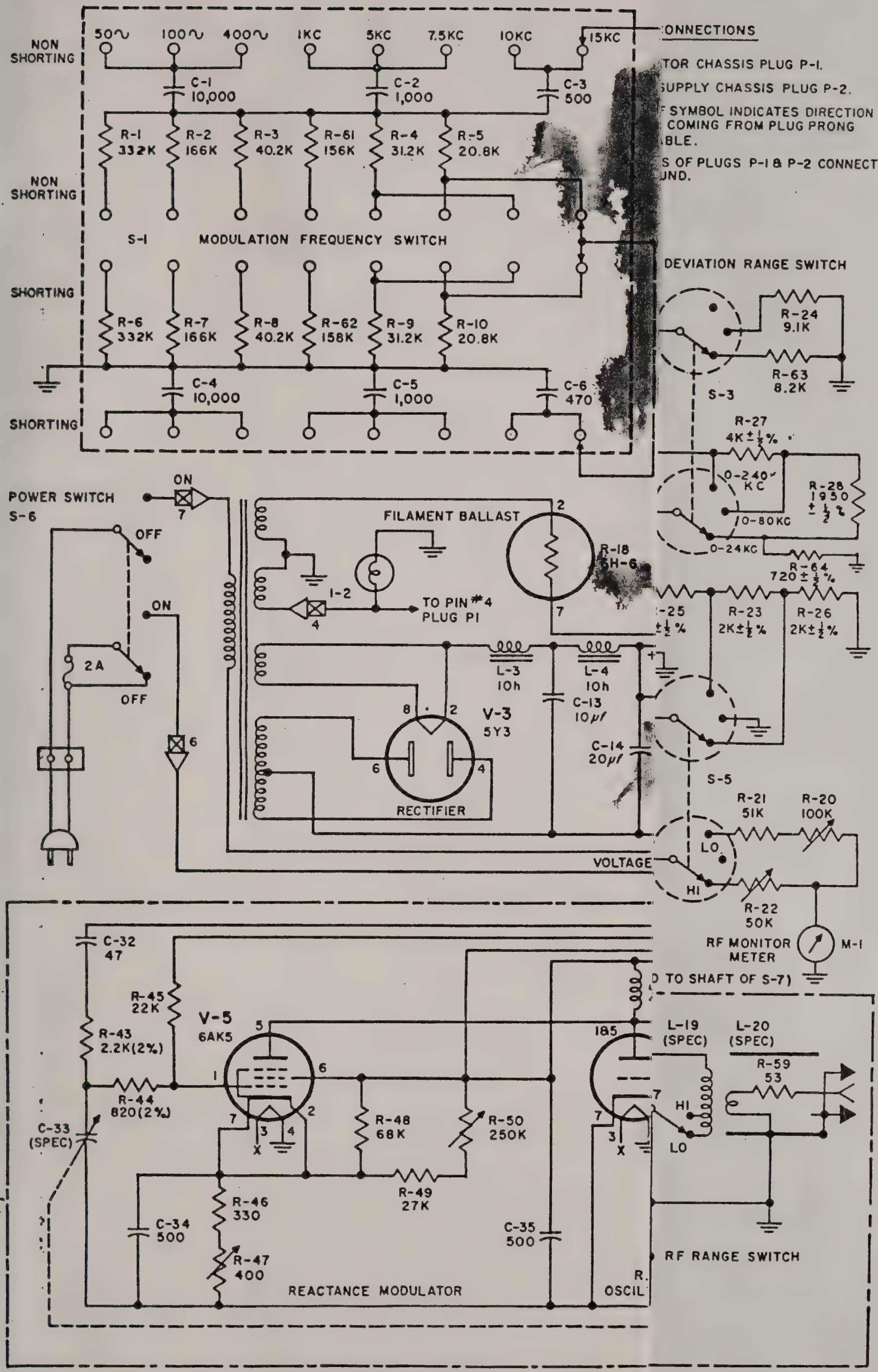
*=NEW ITEM.

ADJ RA FOR 6.45 VDC AT CHASSIS OCTAL SOCKET PIN 7

* +150V VOLTAGE REGULATOR.



*=NEW ITEM.



FM Signal Generator

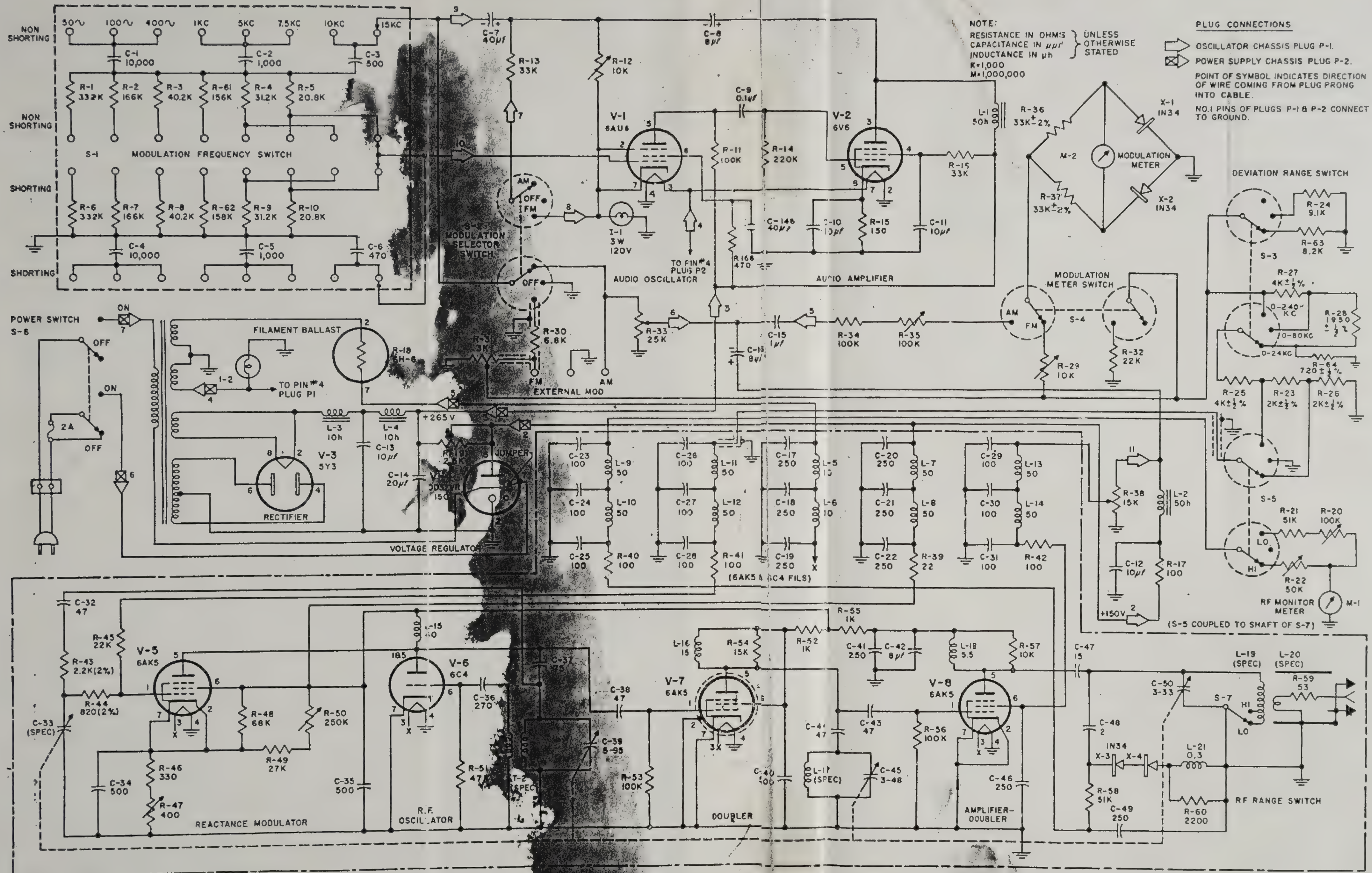


Fig. 8. Schematic Wiring Diagram of 202-B FM Signal Generator

OPERATING INSTRUCTIONS

FOR THE

SIGNAL GENERATOR
TYPE 202-E FM-AM

BOONTON RADIO CORPORATION
BOONTON, NEW JERSEY
U. S. A.

Printed in U.S.A.

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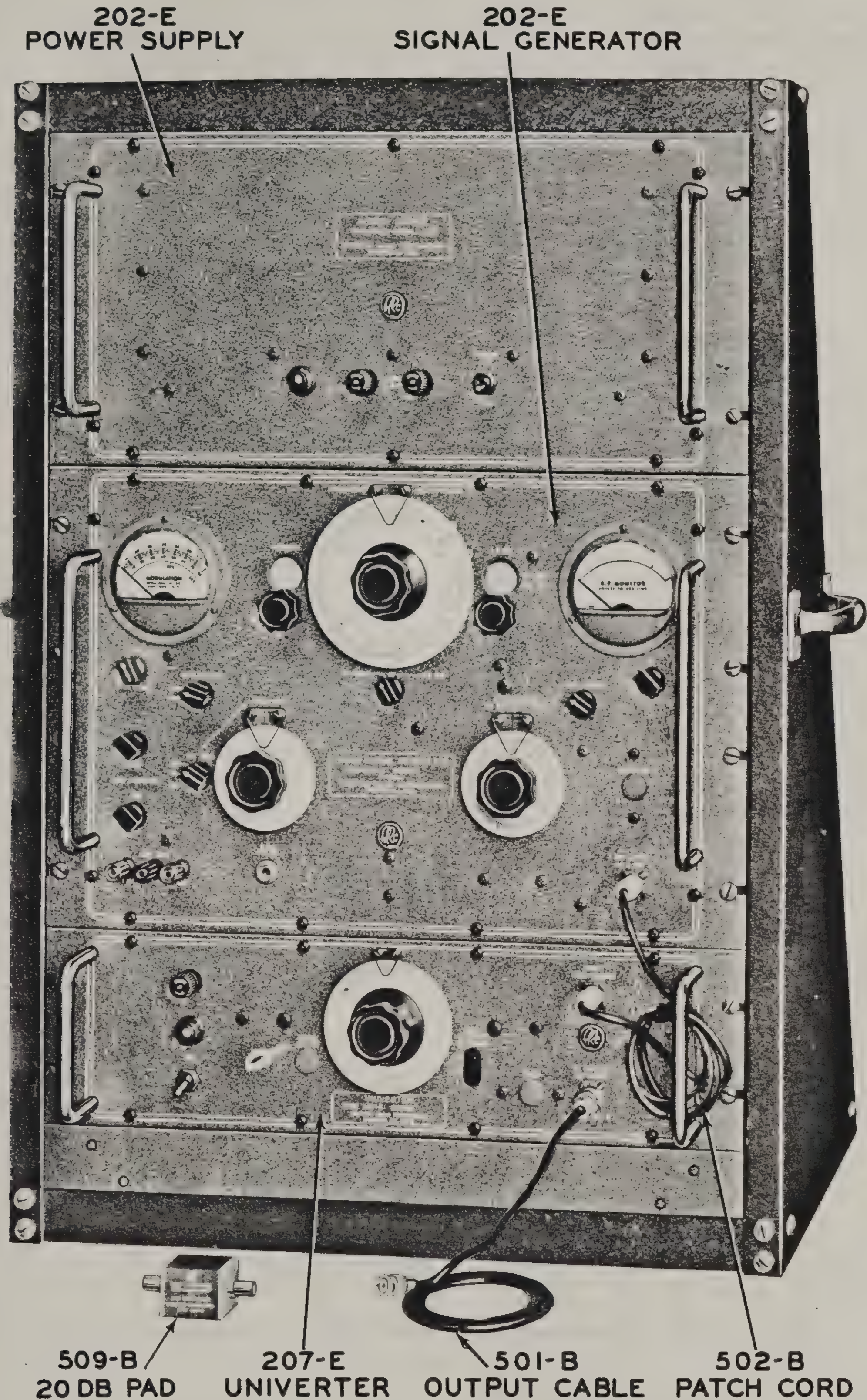


Fig. 1 Rack Mounted View of FM Signal Generator 202-E with Power Supply and Accessory Univerter 207-E

I. INTRODUCTION

GENERAL

The type 202-E Signal Generator has been specifically designed for use in the development and testing of frequency modulated receivers and television FM sound channel equipment within the frequency range of 54 to 216 megacycles. Provisions have also been made whereby it may be used in this frequency range as an amplitude modulated RF signal source or, in conjunction with an external audio oscillator, may be used to produce simultaneous FM and AM RF signals.

Physically this instrument consists of two major assemblies: the signal generator proper and the DC power supply. Each of these assemblies is contained within its own cabinet. The cabinets are so designed that the units may be used as bench type equipment or quickly converted for mounting in a standard 19 inch rack.

In operation the two units are electrically connected by a multi-conductor cable from the rear of the power supply which mates with a connector at the rear of the signal generator. A power cord for connecting the instrument to a suitable line source is also provided at the rear of the power supply.

The generator proper consists of three sub-assemblies: (1) front panel assembly, (2) RF assembly, and (3) audio oscillator assembly. The RF assembly is secured to the rear of the front panel while the audio oscillator is mounted on the side of the cabinet and is electrically connected to the front panel by means of a cable and plug-socket connection.

Meters and calibrated controls are direct reading and, with all other operating controls, are located according to function on the front panels of the units.

The wiring and layout of the various components have been arranged for best performance and maximum simplicity, resulting in compact units of moderate size. For convenience in carrying and protection of the front-panel controls, two utility handles have been provided on the front panel of each unit.

This instrument is supplied complete with tubes, instruction manual, and RF Cable Type 501-B.

BASIC OPERATING PRINCIPLES (Fig. 2)

Figure 2 shows in block form the basic elements employed in the 202-E Signal Generator. A type 6C4 triode is used as an RF oscillator and is tuned over the frequency range of 27-54 megacycles.

Coupled to the RF oscillator is a 6AK5 reactance tube which for frequency modulation, shifts the frequency of the oscillator in direct proportion to the instantaneous audio voltage applied to the reactance tube from the audio modulating oscillator.

The output from the RF oscillator is fed to a Class C frequency doubling stage which is tuned to the second harmonic of the oscillator frequency, thus covering a frequency range of 54 to 108 megacycles. Following this doubling stage is an output stage which in the low frequency range (54 to 108 mc) operates as a Class C amplifier and in the high frequency range (108 to 216 mc) becomes a Class C frequency doubling stage. Amplitude modulation is obtained at this stage

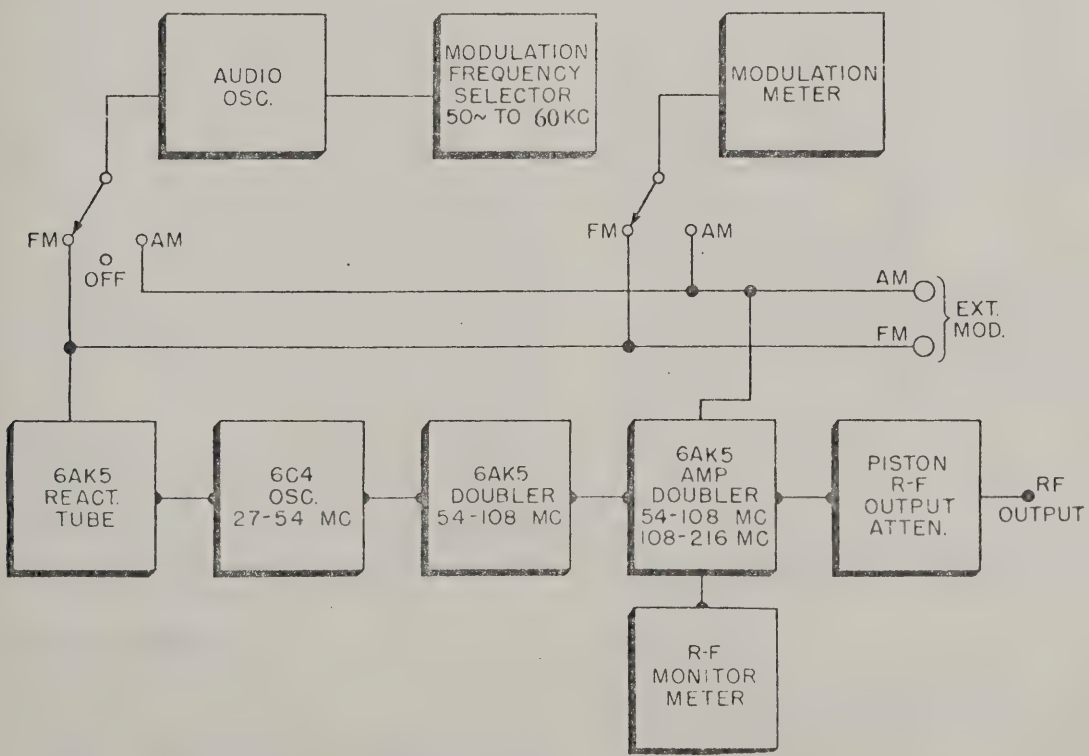


Fig. 2 Basic Elements of 202-E FM-AM Signal Generator

by applying an audio modulating voltage to the screen of the 6AK5 tube.

Coupled to the plate inductor of the output stage is a piston type mutual inductance attenuator having a 50-ohm resistor in series with the one turn coupling loop.

The dial of the attenuator is calibrated in microvolts in terms of the voltage present at the output cable terminal posts when the power output from the last stage is set to the proper level as indicated by the output monitor meter.

The 50-ohm RF output cable is terminated at one end by a 50-ohm resistor and terminal post assembly and at the other end by a BNC type connector which attaches to the RF panel jack. The output impedance of the generator with this cable connected is 25 ohms. The voltage appearing across the output cable terminal posts is read directly on the output attenuator dial.

PRELIMINARY INSTRUCTIONS

The instrument should be carefully removed from the packing carton and the cable from the power supply connected to the signal generator. Connect the power cord to a suitable 115 volt, 50-60 cycle outlet. Operate the Power Switch to the "ON" position. Attach the 501-B Output Cable to the front panel RF Output Jack by pushing in on the cable connector and rotating it clockwise.

Operation of the RF Monitor Control should cause the pointer of the RF Monitor Meter to move. It should be possible to set the meter pointer to the red reference mark over the entire frequency range from 54 to 216 megacycles. This is an indication that the RF oscillator and amplifiers are working properly.

To check the FM and AM modulating systems, turn the Modulation Selector Switch to FM, the Modulation Meter Switch to FM, and the Deviation Range Switch to 24 kc., 80 kc., or 240 kc. Operating the FM Deviation Control in a clockwise direction should cause the Modulation Meter to read increasing deviation. Switch the Modulation Selector Switch to AM, the Modulation Meter Switch to AM, and rotate the Amplitude Modulation Control clockwise. The Modulation Meter should read the degree of amplitude modulation present and full-scale setting should be possible in all but the 60 kc position of the Modulation Frequency Switch.

To prepare this instrument for rack mounting it is necessary only to, (1) remove the externally available screws securing the two end-bells to the cabinets, (2) remove the end-bells exposing the rack mounting holes in the front panels, and (3) remove the four rubber feet from the bottom of each cabinet.

II SPECIFICATIONS

RF Range

Overall frequency coverage of 54 to 216 megacycles in two ranges: 54-108 megacycles and 108-216 megacycles, accurate to within ± 0.5% after a warm-up period of one hour. The main frequency dial is also calibrated in 24 equal divisions for use with the vernier frequency dial.

Vernier Frequency Dial

The vernier frequency dial is divided into 100 equal scale divisions and is mechanically coupled to the main frequency dial by a 24:1 gear train, providing about 2300 logging divisions over each frequency range. The approximate frequency change per vernier division is 26 kc on the low range and 52 kc on the high range.

Fine Tuning Range

The fine tuning control permits continuous tuning over a range of approximately ± 10 kc in the 54 to 108 mc range and ± 20 kc in the 108 to 216 mc range. No calibration is provided.

Incremental Frequency Range

The ΔF switch permits tuning in frequency increments of 0, ± 2.5, ± 5, ± 7.5, ± 10, ± 12.5, ± 15, ± 25, and ± 30 kc in the 54 to 108 mc range and twice these values in the 108-216 mc range. The relative accuracy of the increments is ± 1½%. Overall accuracy is dependent upon the accuracy of the 60 kc modulating frequency (108-216 mc range), and is within ± 6% when the 60 kc accuracy is ± 2% or better, at the carrier frequency checked.

RF Output Voltage

The maximum open circuit output voltage from the BNC type RF output jack at the front panel is about 0.4 volt. With the standard output cable (type 501-B) attached, the maximum calibrated output voltage at the cable terminals is 0.2 volt. When the RF monitor meter is set to the red calibration line and the standard output cable attached, the RF output attenuator is direct reading in microvolts and continuously adjustable from 0.1 microvolt to 0.2 volt. Accuracy is approximately ± 10%.

RF Output Impedances

The RF output impedance of the signal generator as seen looking into the BNC type front panel connector is 50 ohms resistive. With the standard output cable attached, the RF output impedance as seen looking into the output cable terminals is 25 ohms resistive.

Frequency Modulation

Three frequency deviation ranges 0-24 kc, 0-80 kc, and 0-240 kc are provided, each continuously adjustable. Calibrated increments are 1 kc on the 24 kc range, 5 kc on the 80 kc range, and 10 kc on the 240 kc range.

FM Distortion

The overall FM distortion at 75 kc is less than 2% and at 240 kc is less than 10%.

These distortion percentages apply when the front panel fine tuning control is set midway in rotation and the ΔF control at zero electronic deviation, or

when the sum of the fixed deviation and modulation deviation do not exceed the stated deviations.

Amplitude Modulation

1. Internal Modulation: Utilizing the internal audio oscillator, amplitude modulation may be obtained over the range of 0-50%, with meter calibration points provided at 30% and 50% modulation points.

2. External Modulation: Using an external audio oscillator, the RF carrier may be amplitude modulated to 50%.

3. Pulse Modulation: A front panel jack is provided which permits direct connection of an external modulation voltage source to the screen of the final stage for pulse and square wave modulation. When this connection is made the modulation meter and internal circuits are disconnected from the screen element. Approximately 75 volts is required to maintain the carrier at its normal level and about minus 3 volts will shut the carrier off.

AM Distortion

Overall distortion is less than 5% at 30% modulation and less than 8% at 50% modulation.

Fidelity Characteristics

The deviation sensitivity of the FM modulation system as a function of frequency is flat within ± 1 db from 30 cps to 200 kc.

The amplitude modulation system, with the modulation potentiometer at maximum position, is flat within ± 1 db from 30 cps to 200 kc. With the modulation potentiometer at one half of full rotation, the amplitude modulation system is flat within ± 1 db from 30 cps to 70 kc.

Direct connection to the screen element of the final output stage permits square wave or pulse modulation to be applied from an external voltage source. Under these conditions the rise time of the modulation carrier envelope is less than 0.25 microseconds and the decay time less than 0.8 microseconds.

Spurious RF Output

All spurious RF output voltages are at least 30 db below the desired fundamental.

Signal-to-Noise Ratio

The signal-to-noise ratio referred to the level established by 10 kc deviation is better than 60 db in a quiet location. Where considerable noise and vibration are present, the ratio may drop to 55 db.

Frequency Stability

Less than 0.01%/hr. after 2 hour warmup.

Internal AF Oscillator

The internal AF oscillator may be switched to provide either frequency or amplitude modulation; it may also be switched off.

The internal AF oscillator provides eight fixed frequencies which may be selected by a rotary switch, — 50, 100 and 400 cycles, and 1, 5, 7.5, 10 and 60 kc. The 60 kc frequency is provided for calibration of the Incremental Frequency Switch only. Frequency accuracy is within 5% on all but 60 kc, where accuracy is ±2%.

The output of the internal oscillator is available (at the external binding posts) for synchronizing or other applications if desired. Approximately 5 V on the FM posts and 50 V on the AM posts are available.

External Modulation Requirements

1. Frequency Modulation.

The frequency deviation sensitivity is 50 kc per volt on the 0-240 kc deviation range and 16.6 kc per volt on the 0-80 kc deviation range. For external FM the input impedance is 1500 ohms maximum.

2. Amplitude Modulation.

Approximately 45 volts is required for 50% modulation on either the high or low RF range. For external AM the maximum input impedance is 7500 ohms shunted with 1000 mmf.

Simultaneous FM and AM

For certain tests simultaneous FM and AM is sometimes desired. The 202-E FM-AM Signal Generator, in combination with an external low distortion audio oscillator, may be used for this purpose provided that the audio oscillator is capable of developing approximately 5 volts across a 1500 ohm load, the FM requirement for 240 kc deviation.

In use the external audio oscillator is connected to the FM external binding posts, the modulation selector switch set to AM, and the levels of each type of modulation independently set on the modulation meter by operation of the modulation meter switch, FM deviation control, and amplitude modulation control.

CAUTION:

Operation of an external amplitude modulated audio oscillator at a frequency which is the same as or near the audio frequency of the frequency modulated internal oscillator will result in interaction between the modulation circuits.

Power Supply

A separate external power supply furnishes all the dc potentials required for the operation of the 202-E Signal Generator. Output voltages are 250, 150 and 6.9 volts dc, with ripple contents averaging 15 millivolts, less than 1 millivolt, and 25 millivolt, respectively.

Power Requirements

Input to separate power supply: 80 watts at 115 volts, 50 to 60 cycles. For best stability a regulating transformer should supply input power.

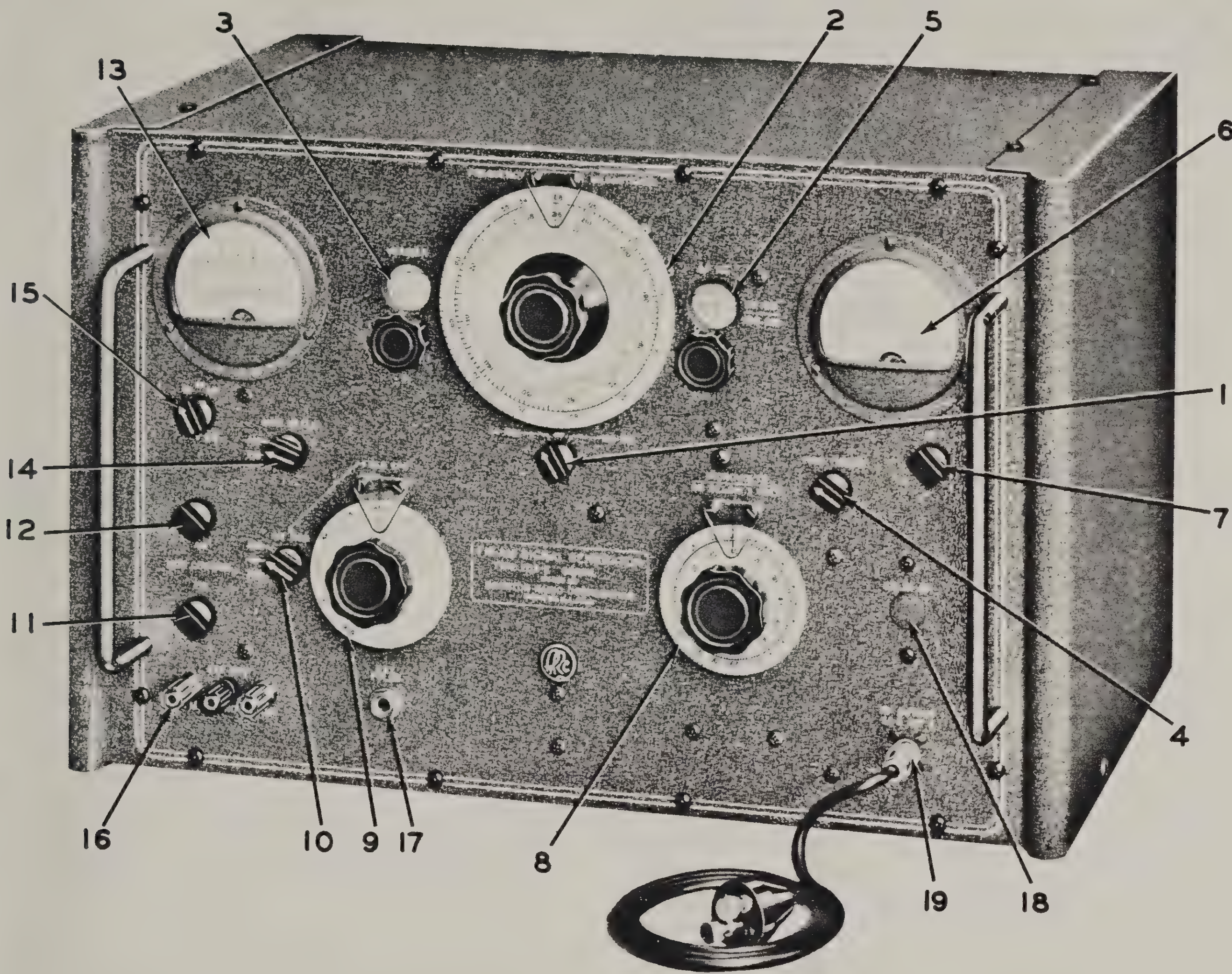


Fig. 3 Front Panel Controls and Layout

Tube Complement

Audio Oscillator	6AU6, 6V6GT/G	(V1, V2)
Rectifier	5Y3GT/G	(V3)
Voltage Regulator	OD3/VR-150	(V4)
Reactance Modulator	6AK5*	(V5)
RF Oscillator	6C4*	(V6)
Doubler Stage	6AK5*	(V7)
Doubler and Output	6AK5*	(V8)
Ballast Resistor	6H-6	(R16)

*Specially Selected. See parts list.

Dimensions

L — 19¼″ W — 12$^{5}/_{16}$″ Depth — 10⅞″

Weight Generator 31 lbs.
Power Supply 27 lbs.

III. OPERATING CONTROLS

POWER SUPPLY (Fig. 1)

Power Switch

This switch applies power to the circuits when in the "ON" position.

Fuses

Two fuses, one in either side of the power transformer primary, to protect the instrument. They are replaceable from the front panel.

Pilot Lamp

A red lamp, which when lit indicates that the circuits are energized. The bulb is replaceable from the front panel.

SIGNAL GENERATOR (Fig. 3)

1. RF Range Switch.

This control selects either the low frequency range, 54-108 megacycles, the high frequency range, 108-216 megacycles, or turns the RF carrier off.

2. Main Frequency Dial.

The Main Frequency Dial has two frequency calibrations, 54-108 megacycles and 108-216 megacycles. An inner scale is divided into 24 equal divisions for use with the Vernier Frequency Dial.

3. Vernier Frequency Dial.

This dial is divided into 100 divisions and is coupled to the Main Frequency Dial through a 24:1 gear train, providing a total of 2300 logging divisions for each RF range.

4. Fine Tuning Control.

This control permits continuous tuning over a range of approximately ± 10 kc on the 54 to 108 mc range, and ± 20 kc on the 108 to 216 mc range. No calibration is provided.

5. Incremental Frequency Switch.

The ΔF Switch permits tuning in increments of 0, ± 2.5, ± 5, ± 7.5, ± 10, ± 12.5, ± 15, ± 25, and ± 30 kc in the 54 to 108 mc range, and twice these values in the 108 to 216 mc range.

6. RF Monitor Meter.

The RF Monitor Meter is used to standardize the power level of the last r-f amplifier stage. In operation the meter pointer is set to the red calibration line on the meter scale.

7. RF Monitor Control.

This adjustment sets the RF Monitor Meter to the proper reference level such that the output attenuator calibration is direct reading in microvolts.

8. RF Output Attenuator.

The RF Output Attenuator Dial is calibrated directly in microvolts output at the output cable terminals. It is standardized by setting the pointer of the RF Monitor Meter to the red calibration mark on the meter scale.

9. Modulation Frequency Switch.

This control selects any one of eight fixed audio frequencies; from 50 cycles to 10 kilocycles for either frequency or amplitude modulation, and 60 kilocycles for calibration of the Incremental Frequency Switch.

10. Modulation Selector Switch.

Either frequency or amplitude modulation may be obtained by setting this switch to the proper position. Modulation may also be turned off.

11. FM Deviation Control.

A continuously variable control for adjusting the frequency deviation on any of the three ranges 0-24 kc, 0-80 kc, or 0-240 kc.

12. Amplitude Modulation Control.

A continuously variable control for adjusting the amplitude modulation level when either the internal AF oscillator or an external AF oscillator is used.

13. Modulation Meter.

Three Modulation Meter scales are provided; 0-24 kc deviation in 1 kc increments, 0-80 kc deviation in 5 kc increments, 0-240 kc deviation in 10 kc increments, 0-50% amplitude modulation, with calibration marks at 30% and 50%.

14. Modulation Meter Switch.

By means of this control the Modulation Meter may be switched to either the FM or AM modulating system to indicate the degree of modulation present.

15. Deviation Range Switch.

This rotary type switch selects three modulation meter deviation ranges, 0-24 kc, 0-80 kc, and 0-240 kc.

16. External Oscillator Binding Posts.

These posts provide a means whereby an external source of modulating voltage may be applied to the instrument.

The output voltage of the internal oscillator is available at the external binding posts for synchronizing or other purposes.

17. Pulse Modulation Jack.

The Pulse Modulation Jack is provided to permit direct connection of an external modulation voltage source to the screen of the final stage for pulse and square wave modulation. When this connection is made the modulation meter and internal circuits are disconnected from the screen element.

18. Calibrate ΔF Control.

This control is used in the calibration of the Incremental Frequency Switch and is accessible by removing the plug button from the generator front panel.

19. RF Output Jack.

This jack makes available for use the generator RF signal.

IV. THEORY OF OPERATION

REACTANCE MODULATION CIRCUIT

A 6AK5 tube (V5) operating as an inductive element across the tank circuit of the 6C4 (V6) oscillator circuit is employed for reactance modulation. In order to maintain constant frequency deviation sensitivity over the entire tuning range of the instrument, the amount of inductance injected by V5 is made to vary directly as the carrier frequency. This is accomplished by a bridged tee network consisting of R43, R44, C33, the grid plate capacitance of V5, and the grid cathode capacitance of V5. Although this circuit

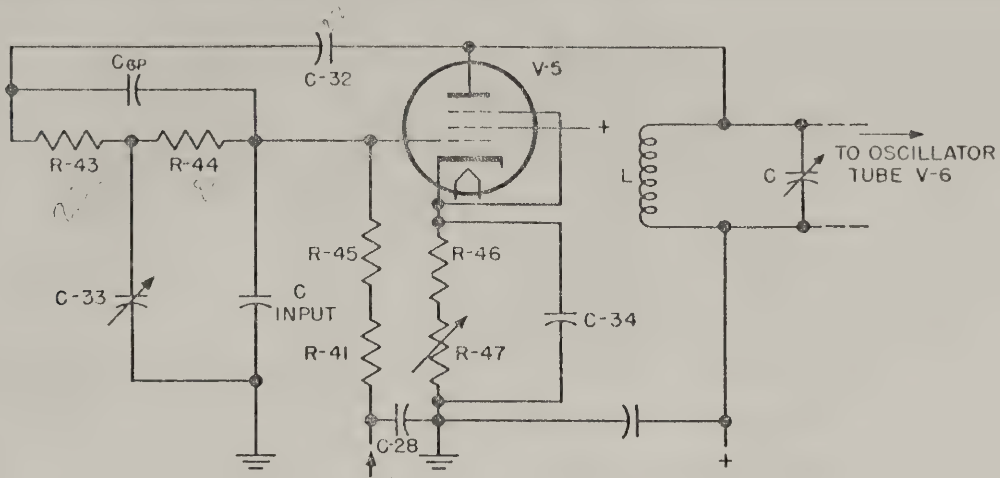


Fig. 4 Basic Reactance Modulator Circuit

arrangement is capable of producing fairly constant deviation with fixed components, C33 is made variable and ganged with the oscillator tuning condenser to provide the precision of deviation calibration required in a signal generator.

Resistor R50 serves to bleed the proper amount of current through R46, R47 to permit operation of V5 over the most linear portion of its characteristics (Fig. 8).

The cathode resistors R46 and R47 which provide bias for V5 are bypassed by C34 for radio frequencies only and degeneration takes place at audio frequencies. Resistor R47 is used to adjust the amount of degeneration present in order to provide the desired deviation sensitivity.

On the high RF range the modulation voltage for FM is reduced to one half in order to maintain the same frequency deviation (Fig. 14). This is accomplished by means of resistors R23, R26, and switch S5 (Fig. 14) which is mechanically coupled to the RF range changing switch. Switch S3 reduces the modulating voltage applied at the reactance tube to one third when operated from the 0-240 kc deviation position to the 0-80 kc deviation position, and to one tenth when operated from the 0-240 kc deviation position to the 0-24 kc deviation position.

For FM, an audio modulating voltage is applied directly to the grid of V5, the reactance tube, through an RF filter which prevents stray RF currents from leaking out of the shielded portion of the instrument.

RF OSCILLATOR (Fig. 14)

A tuned plate RF oscillator covers the frequency range from 27 to 54 mc. Tuning over this range is accomplished by means of capacitor C39 which is ganged to the two other variable tuning capacitors C45 and C50. The plate of V6 is normally operated at about 150 volts DC.

AMPLIFIER DOUBLER STAGE (Fig. 14)

A frequency doubling stage (V7) follows the oscillator and serves the two-fold purpose of (1) permitting the oscillator to be operated at a lower frequency and (2) providing the desired isolation between oscillator and output stage to improve frequency stability. A further advantage is that it provides sufficient drive to saturate the output stage and thus remove any spurious amplitude modulation up to this point. This stage is self-biased and is arranged to track with the oscillator.

OUTPUT STAGE (Fig. 14)

The output stage employs a 6AK5 tube operating in Class C. For the low RF range, this stage functions as an amplifier, and over the high range becomes a frequency doubler. The output tank coil is provided with two contact points located so that when the ground contact is switched from the lower to the upper point, the inductance of the tank coil is changed to double the resonant frequency of the tank circuit. Switching is accomplished by two spring contact fingers, one or the other of which is pressed against a contact point by insulated members on the shaft of the RF RANGE SWITCH. This method avoids most of the mechanical and electrical difficulties usually associated with coil switching. The Q of the tank circuit has been selected to reduce spurious signals by more than 35 db and at the same time keep amplitude modulation to about 2% at 75 kc deviation.

Amplitude modulation is obtained by modulating the screen element of V8, sufficient isolation from the DC supply having been provided by the 50-henry choke, L2.

OUTPUT ATTENUATOR

A piston type RF output attenuator having an internal impedance of 50 ohms is inductively coupled to the tank circuit inductor of the final stage. The pickup loop of the attenuator is continuously adjustable along the axis of the attenuator tube by means of a rack and

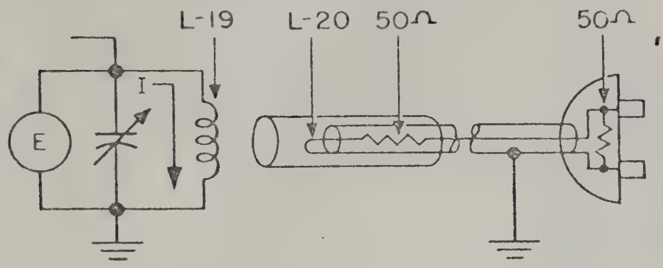


FIG. 5a

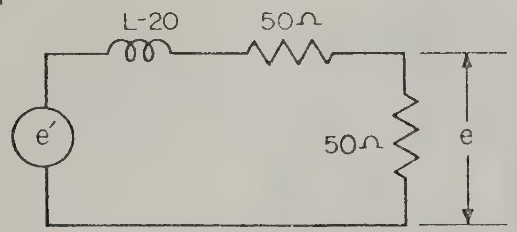


FIG. 5b

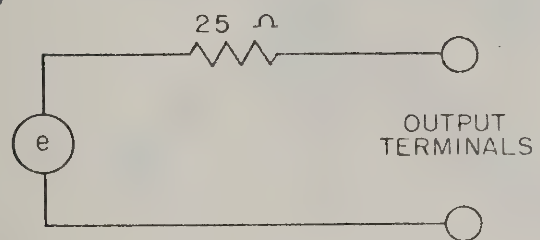


FIG. 5c

Fig. 5 Output Attenuator Equivalent Circuit

pinion drive.

The RG58A/U output cable and BNC panel fittings are of 50 ohm impedance and the output cable is terminated by a 50 ohm carbon film resistor.

Figure 4 shows the basic design of the output attenuator system. The voltage induced in the attenuator coupling loop L20 in figure 4a is:

$$e' = I\omega M = \frac{E}{\omega L_{19}} \times \omega K \sqrt{L_{19} L_{20}} = EK\sqrt{\frac{L_{20}}{L_{19}}}$$

where $\omega = 2\pi$ times the frequency, K is the coefficient of coupling between L_{19} and L_{20}, and M is the mutual inductance between L_{19} and L_{20}.

This equation shows that e′ is a function of the tank voltage E and the coefficient of coupling K only. K is controlled by the attenuation law of the piston attenuator while E is monitored by the output monitor meter.

It can be seen from figure 4b that the voltage e across the terminating resistor is:

$$e = \frac{50\ e'}{100 + j\ (\omega L_{20})} = \frac{50\ e'}{\sqrt{(100)^2 + (\omega L_{20})^2}}$$

Since L_{20} is less than 0.01 microhenry, $(\omega L_{20})^2$ can be neglected in comparison with $(100)^2$ and:

$$e = \frac{e'}{2}$$

Neglecting L_{20} in figure 5b, an application of Thevenin's theorem yields the equivalent circuit shown in figure 4c. Thus the generator can be represented as a source voltage e in series with a resistance of 25 ohms. The attenuator dial is calibrated in terms of the open circuit output voltage e (Fig. 5c) and is direct reading in microvolts from 0.1 microvolt to 0.2 volt when the output monitor meter is set to the red reference line.

If the load impedance is not large compared with ohms, the voltage applied to a load connected at the output terminals can be calculated by using the equivalent circuit of figure 5c.

AF OSCILLATOR (Fig. 14)

The AF oscillator employed is quite free from distortion having, in general, total harmonic content of less than 0.5%. The conventional Wein bridge type of R-C oscillator is used. The series and shunt R-C combinations required to provide the desired modulating frequencies are mounted directly on the rotary type selector switch and are connected by means of two leads to the AF chassis which mounts the oscillator tubes and components. Approximately 50 volts is available from the plate of the 6V6 tube (V2) for modulating purposes, the exact value being controlled by adjustment of R12 which regulates the amount of negative feedback voltage applied to the cathode of V1.

ELECTRONIC TUNING CIRCUITRY (Fig. 14)

The 0.1 mfd blocking condenser C-56 permits application of a DC bias to the reactance tube grid without interfering with frequency modulation by an audio signal. The low frequency half-power frequency is about 12 cps.

Biasing voltage is provided by a No. 1 flashlight cell. Because the battery current drain is only 5 microamperes, its life is practically "shelf life." However, the battery should be replaced every six months to prevent development of noise due to chemical deterioration. The battery is readily accessible by removing the back cover of the generator cabinet.

PULSE MODULATION (Fig. 14)

Pulse Modulation Jack J-1 provides a means for introducing an external voltage source to pulse or square wave modulate the r-f carrier. When this connection is made the modulation meter and internal circuits are disconnected from the screen. Resistor R-96 is in series with the screen lead to damp out any transients which might otherwise occur.

POWER SUPPLY (Fig. 14)

The high voltage supply provides + 265 V unregulated and + 150 V regulated by a VR-150 voltage regulator tube. Resistor R19 is adjusted at the factory to keep the current through the regulator tube within the limits of 5 to 40 milli-amperes when the line voltage is varied from 105 to 125 volts and with the signal generator adjusted for normal operation.

The DC filament voltage is provided by a circuit

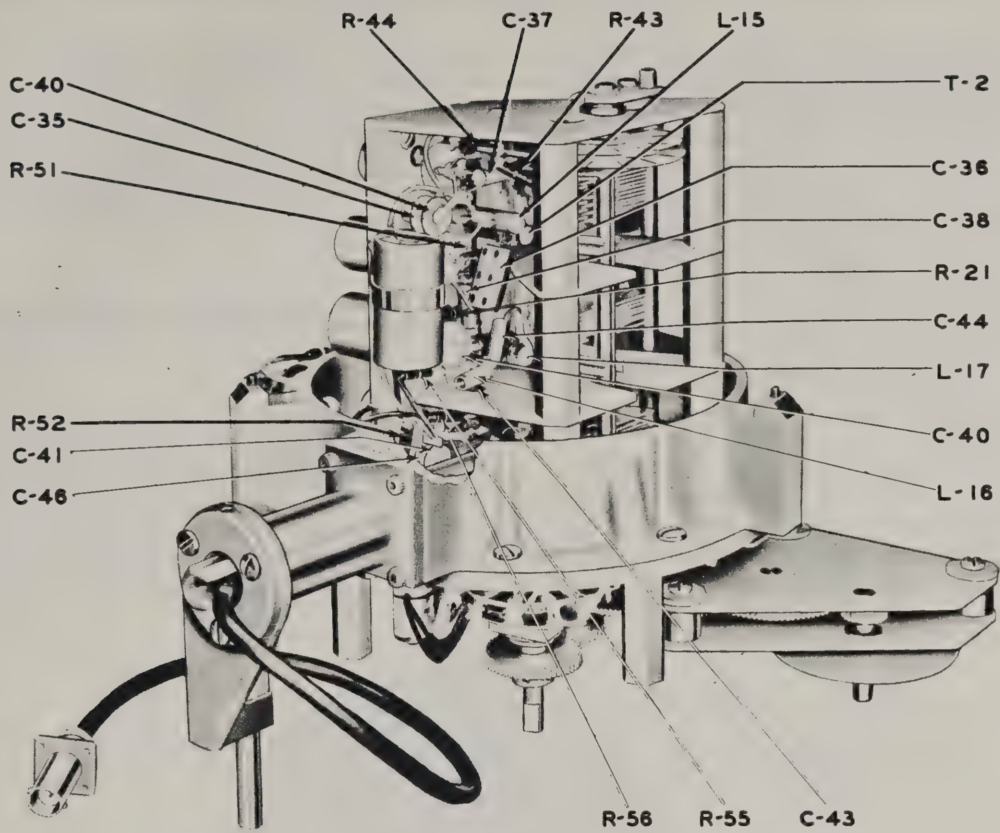


Fig. 6 RF Unit, Left Oblique, Cover Removed

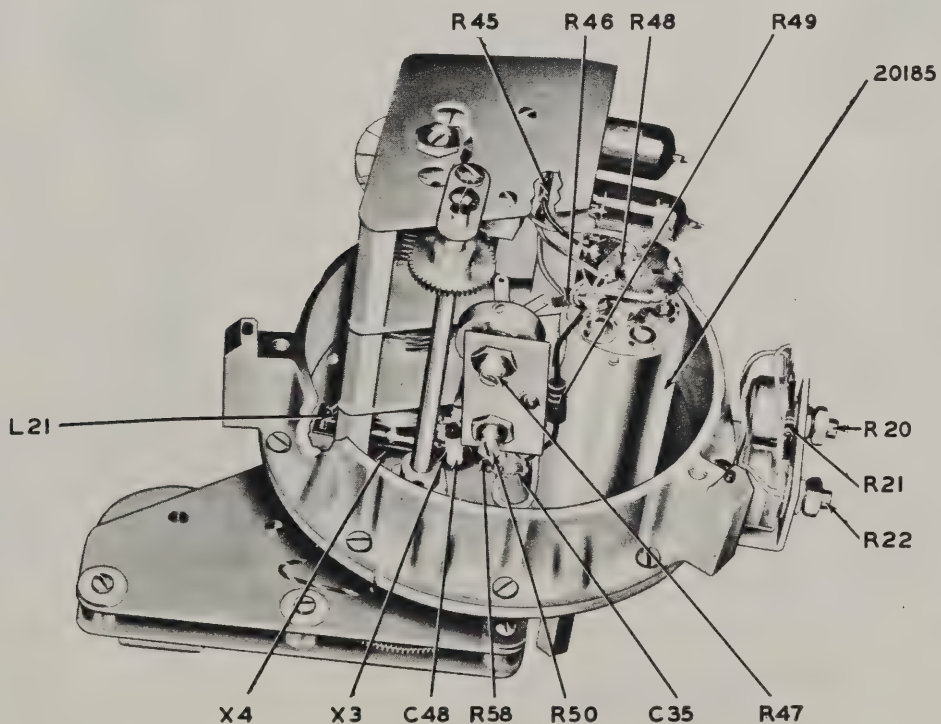


Fig. 7 RF Unit, Right Oblique, Cover Removed

composed of a transformer, bridge type selenium rectifier, choke, and filter condenser. Resistor R66 in the primary of the filament transformer is adjusted at the factory to provide a filament voltage of 6.9 volts at the power cable terminals on the terminal board mounted on the back of the generator front panel.

V. MAINTENANCE INSTRUCTIONS

RF UNIT (Fig. 6)

This unit has been carefully adjusted and calibrated at the factory to meet the specifications listed in this instruction book. Specialized testing equipment and procedures are required which make field adjustments and replacements in the unit difficult and undesirable. For this reason, if any troubles are believed to have developed in the RF Unit, the Signal Generator should be returned to the factory for repair and readjustment, with the factory warranty being voided if our inspection shows damage or misalignment due to adjustments made by the customer.

The DC heater voltage between pin D of plug P-2 and ground (Fig. 6) should measure 6.8 volts. If the RF unit is found to be inoperable and this voltage measures in excess of 7 volts, the trouble is probably due to an open heater circuit at one of the RF tubes. Continued operation of the instrument under this condition will damage the other RF tubes.

AMPLITUDE MODULATION ADJUSTMENT

If desired, the degree of amplitude modulation on the modulation meter can be checked by suitably mixing the output of the generator with another signal source such that a difference frequency of approximately 100-150 kc is produced. This difference fre-

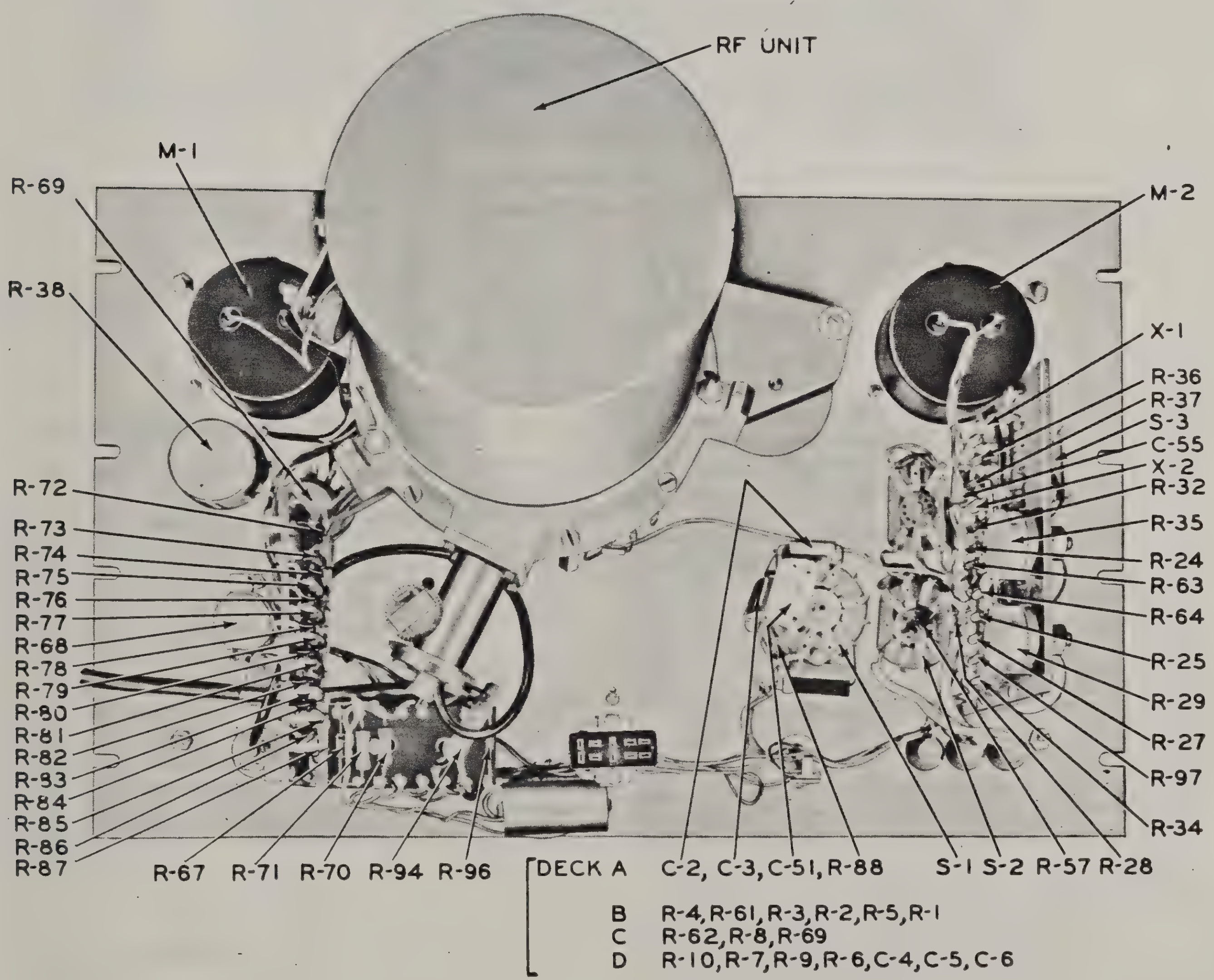


Fig. 8 Control Panel Assembly, Rear View

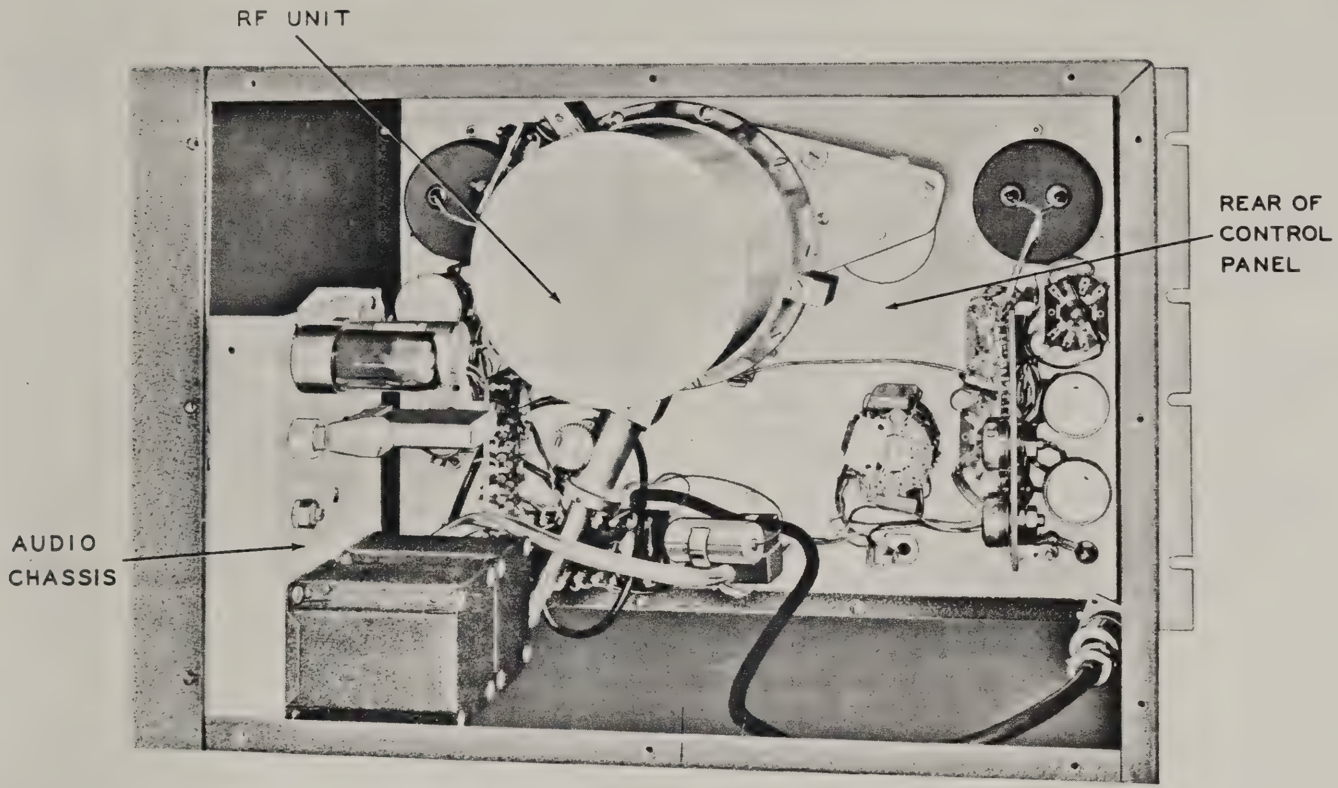


Fig. 9 RF Generator Chassis Assembly, Rear View

quency can be observed visually on a cathode ray oscilloscope and used for adjustment purposes. Adjustment of R35 (Fig. 6) will change the modulation meter AM sensitivity to agree with that degree of modulation present.

FREQUENCY MODULATION ADJUSTMENT

The 6AK5 reactance modulator tube contained within the sealed RF unit has been carefully adjusted for a deviation sensitivity of 50 kc per volt on the low RF range, with the deviation range switch set at the 0-240 kc position. If for any reason it is desired to check the carrier deviation, this may be accomplished using the Crosby* or carrier zero method of measurement.

A selective communications superheterodyne receiver tuned to the RF output of the generator can be used as a null indicator to determine the exact point at which the carrier current disappears.

Since the modulation index B is defined as the ratio of the frequency deviation ΔF to the modulating frequency f, or

$$B = \frac{\Delta F}{f}$$

the frequency deviation is given by:

$$\Delta F = B \times f$$

The carrier will reach its minimum value at the following modulation indices:

2.404; 5.5201; 8.653; 11.791; 14.930; 18.071; 21.2116, etc.

The FM deviation indicated on the modulation meter is controlled by the setting of R29 (Fig. 14). A slight adjustment of this control may be made if desired; however the actual deviation sensitivity of the reactance modulator is adjusted by means of R47 (Fig. 14) within the RF shield, and should not be disturbed.

INCREMENTAL FREQUENCY SWITCH CALIBRATION

The incremental Frequency Switch can be calibrated with the aid of a narrow band frequency modulation receiver (which operates in the frequency range of 108 to 216 mc) equipped with a tuning meter.

1. Set the Incremental Frequency Switch at "0" and the Fine Tuning control at mid-rotation. Apply a 1,000 microvolt signal to the antenna connection of the receiver and carefully tune the signal generator with the Vernier Frequency Control until the receiver tuning meter indicates perfect tuning.

2. Adjust the signal generator for a frequency modulation deviation of about 10 kc at a 60 kc modulation frequency. This will produce side bands spaced 60 kc above and below the carrier frequency.

3. Turn the Incremental Frequency Switch to + 60 kc. The lower side band should now fall in the passband of the receiver. If the tuning meter does not

indicate perfect tuning, adjust the calib. ΔF potentiometer on the generator front panel. Recheck the tuning of the carrier with the Incremental Frequency Switch at "0" and repeat the procedure if necessary.

4. The Incremental Frequency Switch can also be calibrated with the aid of a communications type receiver equipped with a beat frequency oscillator. The method will be apparent from the description given above.

VR-150 REGULATOR TUBE (Fig. 12)

When replacing this tube (V4) it is desirable to check its current drain by placing a milliameter in series with the plate and adjusting R19 for a 7 milliampere plate current with the input voltage to the power transformer primary set at 105 volts. The adjustment will insure proper operation of the power supply over a line voltage range of 105-125 volts.

BATTERY, NO. 1 CELL

It is recommended that the battery be replaced every six months. It is accessible by removing the back cover of the generator cabinet.

VI. TROUBLE-SHOOTING

Many cases of non-operation or malfunctioning are the result of tube failure. A visual inspection will often show a tube inoperative, and its replacement will restore normal performance.

If all the tubes light, but performance is abnormal, the tubes should be checked in a tube tester, and returned, if good, to the sockets from which they were removed.

To facilitate the detection and localization of possible trouble, two charts are presented in the following pages. The first, a "Trouble Chart", lists by symptoms some known trouble conditions and their remedies. The second "Socket Voltage Chart", gives average operating potentials under the stated conditions.

TROUBLE CHART

Symptom	*Probable Cause*	*Remedy*
With Equipment Connected to a suitable 115-Volt Source and Power Switch "ON", Panel lamp does not light.	Fuse Defective.	Replace fuse with 2A. Littlefuse No. 3AG-2.
	Panel Lamp Open.	Replace Panel Lamp.
	Primary winding or lamp secondary winding of Power transformer open.	Check continuity of Transformer and replace if found defective.
Not all vacuum tube filaments light.	Defective Vacuum tube.	Test for defective tube using tube tester.
	Filament Ballast R-90 open.	Replace R-90 with 6H-6 Ballast tube.
No vacuum tube filaments light.	Primary or secondary winding of Filament Transformer open.	Check continuity of Transformer and replace if found defective.
	Selenium Rectifier defective.	Replace X-5.
	C-52 defective.	Check and replace if found defective.
	L-22 open.	Check continuity of choke and replace if found defective.
Fuse blows repeatedly as soon as power is applied, or blows sometime after power is applied.	V-3, C-12, C-13, C-14, Power Transformer, or Filament Transformer defective.	Remove V-3. If fuse does not blow with V-3 removed, check C-12, C-13, C-14 for possible short. If normal, test V-3 in tube tester.
Filaments light but no Plate Voltages.	V-3 defective.	Replace V-3.
	L-3 or L-4 open.	Check continuity of L-3 and L-4.
	C-12, C-13, or C-14 shorted.	Check respective parts replacing any part found defective.

TROUBLE CHART cont.

Symptom	*Probable Cause*	*Remedy*
	Defective connection to terminal B of Plug P-2.	Check Terminal connections and wiring continuity of Plug P-2.
RF Unit Inoperative.	R-17 defective.	Check R-17 and replace if found defective.
	C-12 shorted.	Check C-12 and replace if found defective.
	Defective connection to terminal E of Plug P-2.	Check terminal connections and wiring continuity.
	*Plug P-1 from Audio Oscillator not plugged into Front Panel Socket.	Connect Plug P-1 to Front Panel socket.

**NOTE: No RF output will be obtained with the audio oscillator plug P detached from the front panel assembly since the DC screen supply for the final amplifier double tube, V8, is wired from the power supply through the audio unit and thence to the RF panel.*

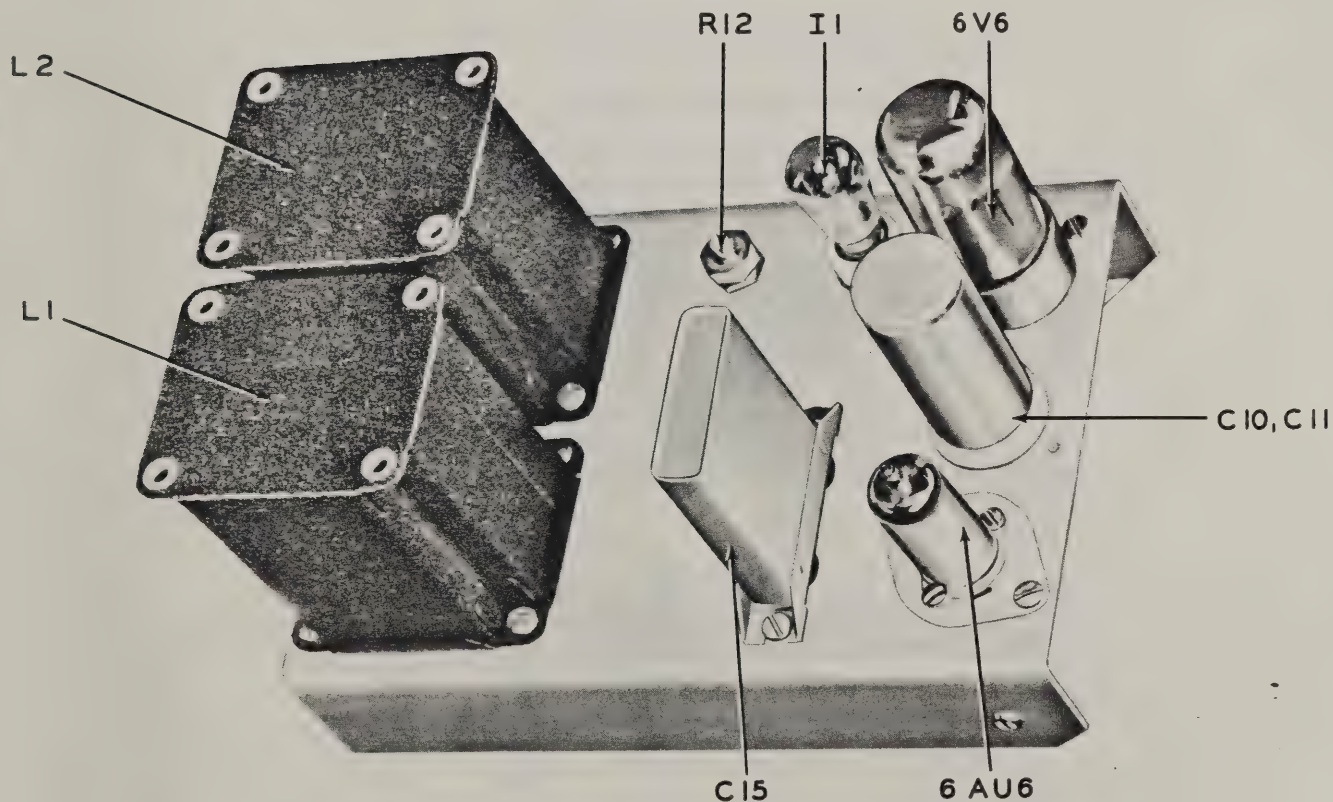


Fig. 10 Audio Oscillator Assembly, Top View

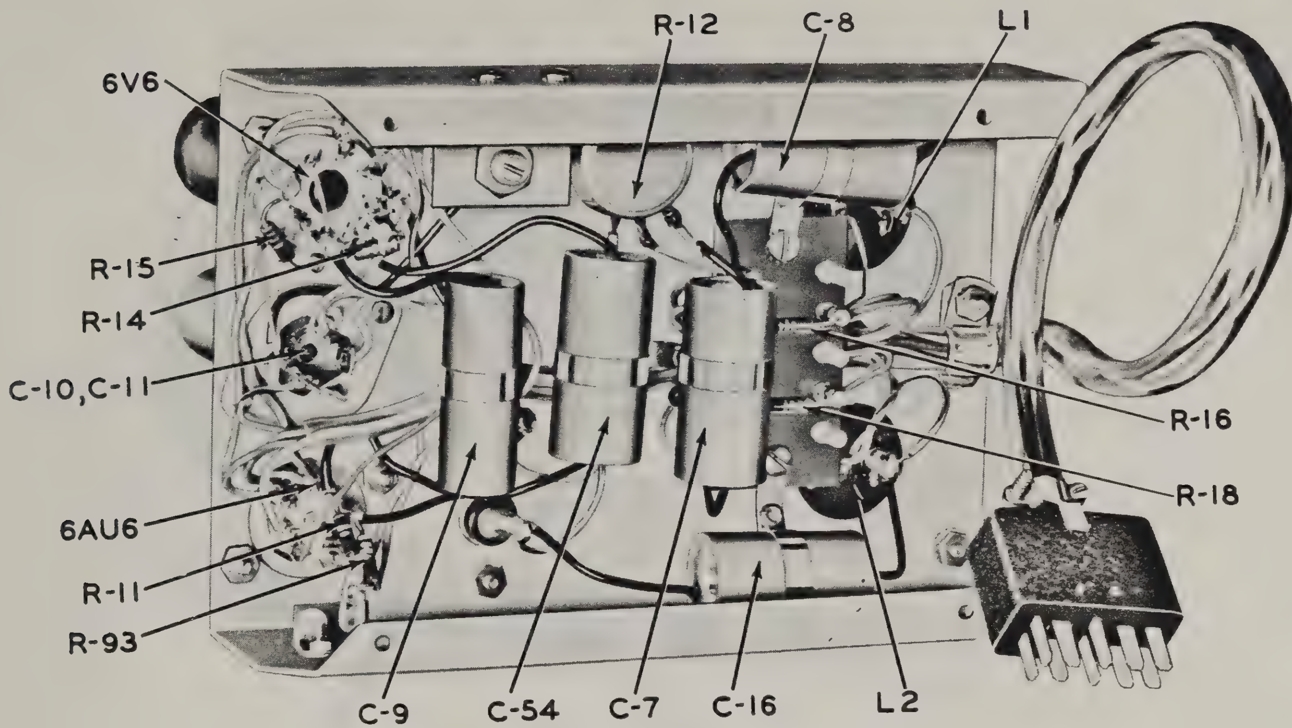


Fig. 11 Audio Oscillator Assembly, Bottom View

SOCKET VOLTAGE CHART

All voltages are DC unless otherwise indicated.
All DC measurements are made with 20,000 ohms per volt voltmeter.
All AC measurements are made with 1000 ohms per volt AC voltmeter.

Conditions for measurements:

a. Measurements made with respect to ground.
b. RF RANGE SWITCH set at 108-216 mc position.
c. FREQUENCY MC DIAL set at 216 mc.
d. ATTENUATOR DIAL set at 100K Microvolt.
e. MODULATION SWITCH off.
f. RF MONITOR METER set at red line.
g. MODULATION METER SWITCH at FM.
h. MODULATION FREQUENCY SWITCH at 400 cps.

	Pin Numbers							
Tubes	1	2	3	4	5	6	7	8
V-1 (6AU6)	0	2.4	0	6.3	150	85	2.4	
V-2 (6V6)	0	6.3	220	0	0	0	0	5.2
V-3 (5Y3)	0	290	0	400 A.C.	0	400 A.C.	0	290
V-4 (VR-150)	0	0	0	0	150	0	0	0
R-18 (6H-6)	0	6.7	0	0	6.3	0	14.2	0
V-5 (6AK5)	0	4.2	6.2	0	130	130	4.2	
V-6 (6C4)	130	0	6.2	0	130	1.5	0	
V-7 (6AK5)	0.25	0	6.2	0	134	135	0	
V-8 (6AK5)	0.6	0	6.2	0	140	103	0	

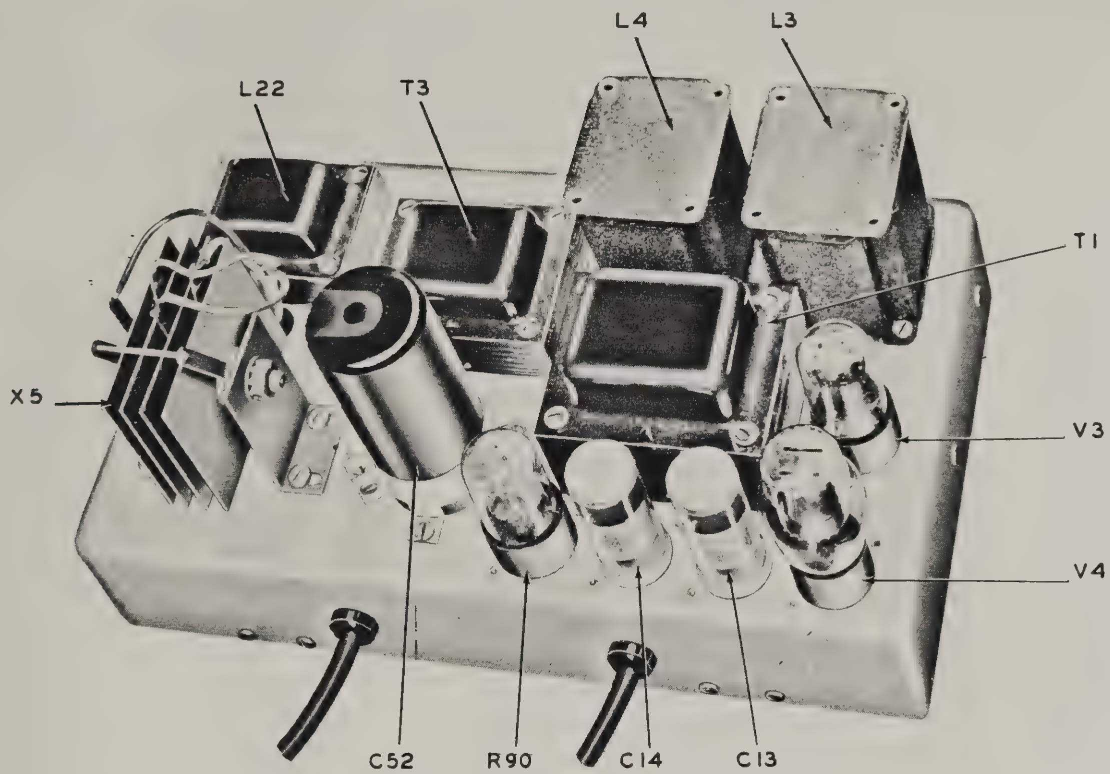


Fig. 12 Power Supply, Top View

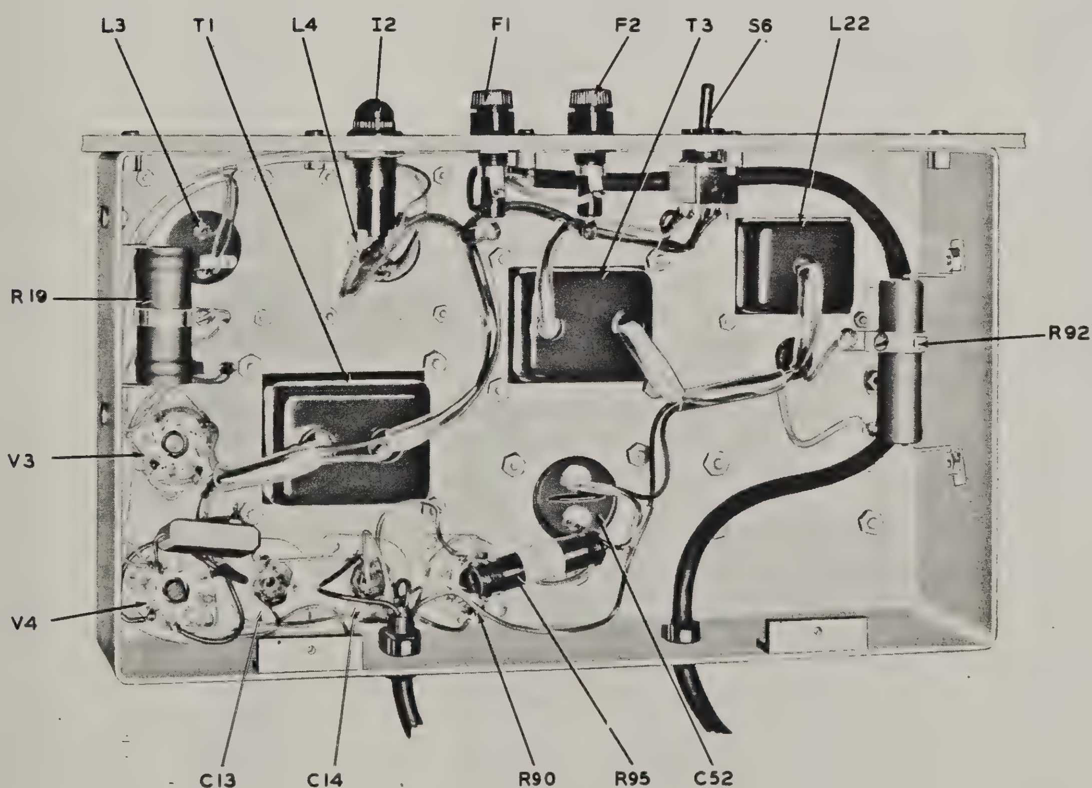


Fig. 13 Power Supply, Bottom View

VII. LIST OF REPLACEABLE PARTS

The following parts are replaceable. After replacement it is desirable to make the checks and adjustments described in Section V.

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST

Circuit Symbol	Value	Description	BRC Part No.
R-1,6	332KΩ	Resistor, Fixed ±1% 1/2W Carbon	80630
R-2,7	166KΩ	Resistor, Fixed ±1% 1/2W Carbon	80567
R-3,8	40.2KΩ	Resistor, Fixed ±1% 1/2W Carbon	80492
R-4,9	31.2KΩ	Resistor, Fixed±1% 1/2W Carbon	80491
R-5,10	20.8KΩ	Resistor, Fixed ±1% 1/2W Carbon	80490
R-11,21,67	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-12,29,35	10KΩ	Resistor, Var. ±10% 2W	81314
R-13,16	33KΩ	Resistor, Fixed±5% 1/2W Carbon	80461
R-14	220KΩ	Resistor, Fixed ±5% 1/2W Carbon	80555
R-15	150Ω	Resistor, Fixed ±5% 1/2W Carbon	80098
R-17	100Ω	Resistor, Fixed ±5% 1/2W Carbon	80062
R-20	250KΩ	Resistor, Var. ±10% 2W	81601
R-21	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-22	100KΩ	Resistor, Var. ±10% 2W	81507
R-19	2.5KΩ	Resistor, Adjustable ±5% 25W	80268
R-23,26	2KΩ	Resistor, Fixed ±1/2% 1/2W Carbon	80216
R-24	9.1KΩ	Resistor. Fixed ±5% 1/2W Carbon	80327
R-25,27	4KΩ	Resistor, Fixed ±1/2% 1/2W Carbon	80247
R-28	1950Ω	Resistor, Fixed ±1/2% 1/2W Carbon	80206
R-30	6.8KΩ	Resistor, Fixed ±5% 1/2W Carbon	80387
R-31	3KΩ	Resistor, Var. ±5% 3W	81210
R-32,34	22KΩ	Resistor, Fixed ±5% 1/2W Carbon	80472
R-33	25KΩ	Resistor, Var. ±10% 3W	81411
R-36,37	33KΩ	Resistor, Fixed ±2%, 1/2W Carbon	80486
R-38	15KΩ	Resistor, Var. ±5% 3W	81331
R-43	2.2KΩ	Resistor, Fixed ±2% 1/2W Carbon	80269
R-44	820Ω	Resistor, Fixed ±2% 1/2W Carbon	80183
R-45	4.7KΩ	Resistor, Fixed ±5% 1/2W Carbon	80304
R-46	330Ω	Resistor, Fixed ±5% 1/2W Carbon	80172
R-47	500Ω	Resistor, Var. ±10% 2W	81128
R-48	68KΩ	Resistor, Fixed ±5% 1/2W Carbon	80552
R-49	27KΩ	Resistor, Fixed ±5% 1/2W Carbon	80487
R-50	250KΩ	Resistor, Var. ±20% 2W	81608
R-51	47KΩ	Resistor, Fixed ±5%1/2W Carbon	80460
R-52	1KΩ	Resistor, Fixed ±5% 1/2W Carbon	80148
R-53	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-54	15KΩ	Resistor, Fixed ±5% 1/2W Carbon	85572
R-55	1KΩ	Resistor, Fixed ±5% 1/2W Carbon	80148
R-56	100KΩ	Resistor, Fixed ±5% 1/2W Carbon	80517
R-57	10KΩ	Resistor, Fixed ±5% 1/2W Carbon	80361
R-58	51KΩ	Resistor, Fixed ±5% 1/2W Carbon	80437
R-59	50Ω	Resistor, Fixed ±1% 1/4W Film	80048
R-60	1000Ω	Resistor, Fixed ±5% 1/2W Carbon	85585
R-61,62	156KΩ	Resistor, Fixed ±1% 1/2W Carbon	80566
R-63	8.2KΩ	Resistor, Fixed ±5% 1/2W Carbon	80326

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST - *Continued*

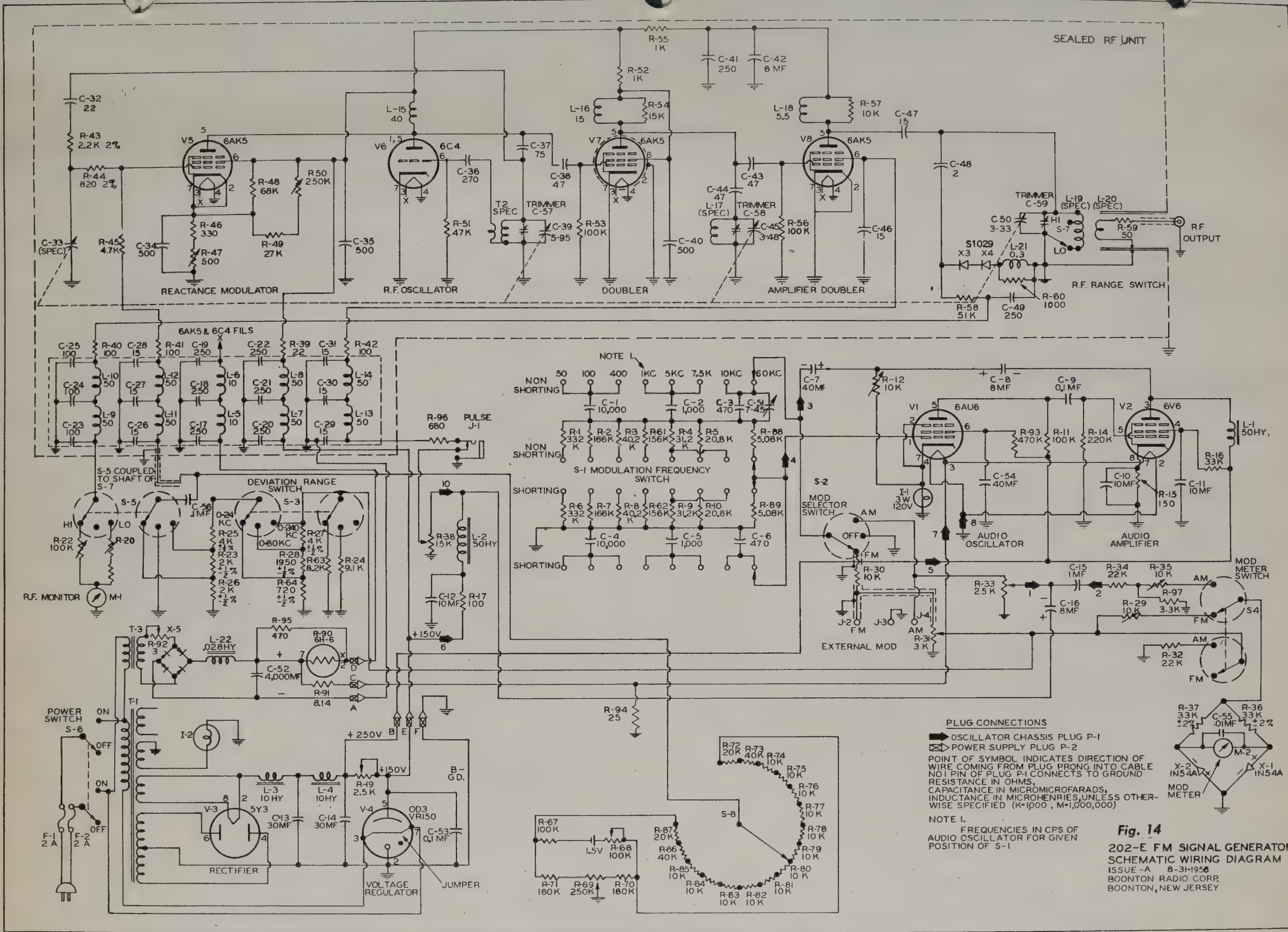
Circuit Symbol	Value	Description	BRC Part No.
R-64	720 Ω	Resistor, Fixed ±1/2% 1/2W Carbon	80147
R-68	100KΩ	Resistor, Var. ±10% 2W	81507
R-69	250KΩ	Resistor, Var. ±10% 2W	81616
R-70,71	180KΩ	Resistor, Fixed ±1% 1/2W Carbon	80534
R-72,87	20KΩ	Resistor, Fixed ±1% 1/2W Carbon	80344
R-73,86	40KΩ	Resistor, Fixed ±1% 1/2W Carbon	80426
R-74--85	10KΩ	Resistor, Fixed ±1% 1/2W Carbon	80330
R-88,89	5.08KΩ	Resistor, Fixed ±1% 1/2W Carbon	80312
R-90		Resistor, Thermal	91019
R-91	8.14Ω	Resistor, Fixed ±1% 10W	80019
R-92	3Ω	Resistor, Adjustable ±5% 25W	80004
R-93	470KΩ	Resistor, Fixed ±5% 1/2W Carbon	80640
R-94	25Ω	Resistor, Fixed ±10% 4W Carbon	80727
R-95	470Ω	Resistor, Fixed ±5% 1/2W Carbon	80170
R-96	680Ω	Resistor, Fixed ±5% 1/2W Carbon	80138
R-97	3.3KΩ	Resistor, Fixed ±5% 1/2W Carbon	80253
C-1,4	10,000μμf	Cap., Fixed ±2% 300V Mica	82413
C-2,5	1000μμf	Cap., Fixed ±2% 500V Mica	82302
C-3,6	470μμf	Cap., Fixed ±2% 500V Mica	82239
C-7,54	40μf	Cap., Fixed 150V Electrolytic	83045
C-8,16	8μf	Cap., Fixed 450V Electrolytic	83028
C-9	0.1μf	Cap., Fixed +20%-10% 400V Elec.	83070
C-10,11,12 13,14	10-10-10μf	Cap., Fixed 400V Electrolytic	83050
C-15	1μf	Cap., Fixed +20%-10% 400V Elec	83066
C-17	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-18	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-19	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-20	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-21	250μμf	Cap., Fixed ±10% 500 V Sil Mica	82232
C-22	250μμf	Cap., Fixed ±10% 500V Sil Mica	82232
C-23	100μμf	Cap., Fixed ±10% 500V Sil Mica	82140
C-24	100μμf	Cap., Fixed ±10% 500V Sil Mica	82140
C-25	100μμf	Cap., Fixed ±10% 500V Sil Mica	82140
C-26	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-27	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-28	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-29	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-30	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-31	15μμf	Cap., Fixed ±10% 500V Sil Mica	82018
C-32	22μμf	Cap., Fixed, ±5% 500V Ceramic	82030
C-33	Special	Cap., Variable	20207
C-34	500μμf	Cap., Fixed ±10% 500V Sil Mica	82235
C-35	500μμf	Cap., Fixed ±10% 500V Sil Mica	82231
C-36	270μμf	Cap., Fixed ±5% 500V Mica	82237
C-37	75μμf	Cap., Fixed ±5% 500V Ceramic	82135
C-38,43,44	47μμf	Cap., Fixed ±5% 500V Ceramic	82132
C-39	5-95μμf	Cap., Variable Air Dielectric	20207
C-40	500μμf	Cap., Fixed ±10% 500VSil Mica	82235
C-41	250μμf	Cap., Fixed ±10% Sil Mica	82236

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST - Continued

Circuit Symbol	Value	Description	BRC Part No.
C-42	8μμf	Cap., Fixed 450V Electrolytic	83029
C-43	47μμf	Cap., Fixed ±5% 500V Ceramic	82132
C-44	47μμf	Cap., Fixed ±5% 500V Ceramic	82132
C-45	3-48μμf	Cap. Variable Air Dielectric	20207
C-46	15μμf	Cap., Fixed ±10% 500V Sil Mica	82014
C-47	15μμf	Cap., Fixed ±5% 500V Ceramic	82031
C-48	2μμf	Cap., Fixed ±5% 500V Ceramic	82136
C-49	250μμf	Cap., Fixed ±10% 500V Sil Mica	82230
C-50	3-33μμf	Cap., Variable Air Dielectric	20207
C-51	7-45μμf	Cap., Trimmer, Screw Type	84039
C-52	4000μf	Cap., Fixed 25V Electrolytic	83097
C-55	.01μf	Cap., Fixed 200V Paper	82402
C-57		Special	
C-58		Special	
C-59		Special	
L-1,2	50h	Choke, Filter	85433
L-3,4	10h	Choke, Filter	85535
L-5	10μh	Coil, Radio Frequency	85575
L-6	10μh	Coil, Radio Frequency	85575
L-7	50μh	Coil, Radio Frequency	85592
L-8	50μh	Coil, Radio Frequency	85592
L-9	50μh	Coil, Radio Frequency	85592
L-10	50μh	Coil, Radio Frequency	85592
L-11	50μh	Coil, Radio Frequency	85592
L-12	50μh	Coil, Radio Frequency	85592
L-13	50μh	Coil, Radio Frequency	85592
L-14	50μh	Coil, Radio Frequency	85592
L-15	40μh	Coil, Radio Frequency	85573
L-16	15μh	Coil, Radio Frequency	85572
L-17	Special	Coil, Radio Frequency	85582
L-18	5.5μh	Coil, Radio Frequency	85584
L-19	Special	Coil, Radio Frequency	85583
L-20	Special	Coil, Radio Frequency	80088
L-21	0.3μh	Coil, Radio Frequency	85585
L-22	0.028h	Choke, Filter	300109
B-1		Battery, No.1 Cell, 1.5V	86707
F-1,2		Fuse, 2A	93251
I-1		Lamp, Incandescent, 120V, 3W	90907
I-2		Lamp, Incandescent, 6.3V, 0.15A	90904
J-1		Jack, Midget	89039
J-2,4		Jack, Binding Post, Insulated	304312
J-3		Jack, Binding Post	304311
J-5		Jack, BNC	89065
P-1		Plug, 10 male contacts	303335
P-2		Plug, 7 female contacts	300113

TYPE 202-E ELECTRICAL COMPONENT PARTS LIST - *Continued*

Circuit Symbol	Value	Description	BRC Part No.
S-1		Switch, Rotary, 4 pole, 8 position 4 section	88058
S-2, 3		Switch, Rotary, 2 pole, 3 position 1 section	88083
S-4		Switch, Rotary, 2 pole, 2 position 1 section	88060
S-6		Switch, Toggle, DPDT	88059
S-8		Switch, Rotary, pole, 17 position	88097
T-1		Transformer, Power, 117V, 50-60 cps	85074
T-3		Transformer, Filament, 117V to 24V	300107
V-1		Tube	6AU6
V-2		Tube	6V6
V-3		Tube	5Y3
V-4		Tube	OD3/VR-150
V-5		Tube (selected 6AK5)	543A
V-6		Tube (selected 6C4)	544A
V-7		Tube(selected 6AK5)	543B
V-8		Tube (selected 6AK5)	543A
X-1 , 2	1N54A	Crystal Diode, Germanium	91091
X-3, 4	S1029	Crystal Diode, Germanium	91093
X-5		Rectifier, Selenium	302622
		RF Unit, Complete	20205
		Holder, Fuse, Extractor Post	93677
		Light, Indicator, Miniature Bayonet	303876
		Lampholder, Candelabra Base	89026
		Socket, 10 Female Contacts	Jones
		Socket, 7 Male Contacts	Amphenol
M-1		Meter, 100μa, special scale	92026
M-2		Meter, 100μa, special scale	92025



PLUG CONNECTIONS

OSCILLATOR CHASSIS PLUG P-1

POWER SUPPLY PLUG P-2

POINT OF SYMBOL INDICATES DIRECTION OF WIRE COMING FROM PLUG PRONG INTO CABLE
NO 1 PIN OF PLUG P-1 CONNECTS TO GROUND
RESISTANCE IN OHMS,
CAPACITANCE IN MICROMICROFARADS,
INDUCTANCE IN MICROHENRIES, UNLESS OTHERWISE SPECIFIED (K=1000, M=1,000,000)

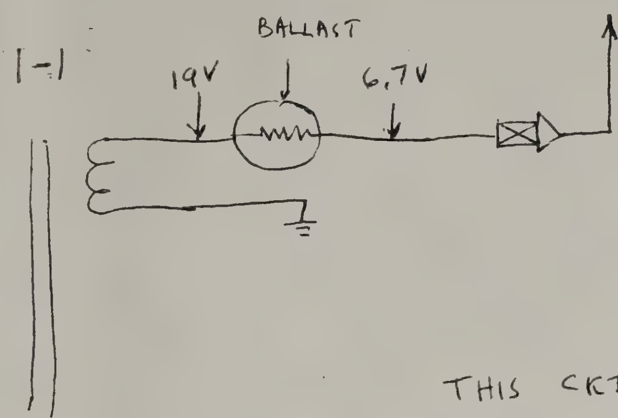
NOTE 1.

FREQUENCIES IN CPS OF AUDIO OSCILLATOR FOR GIVEN POSITION OF S-1

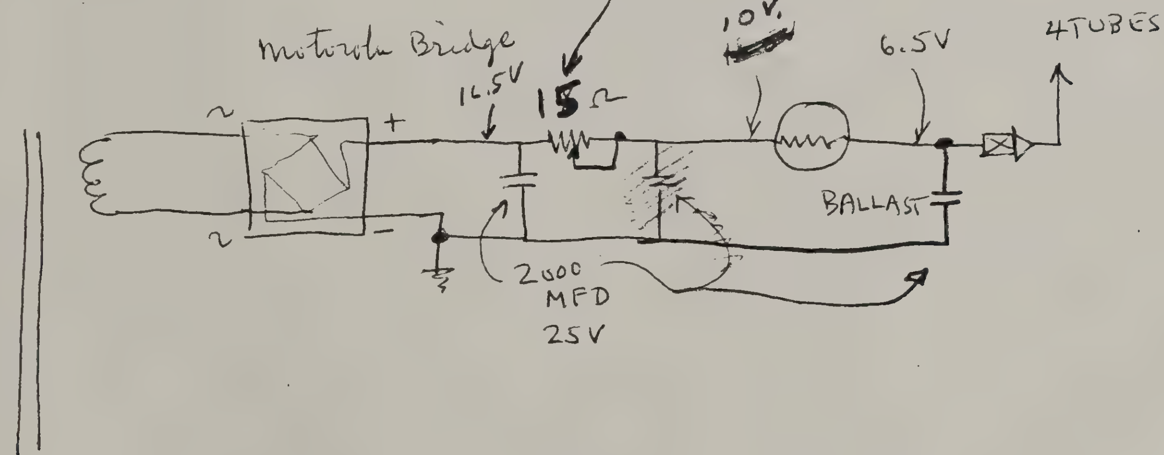
Fig. 14

202-E FM SIGNAL GENERATOR
SCHEMATIC WIRING DIAGRAM
ISSUE - A 8-31-1956
BOONTON RADIO CORP.
BOONTON, NEW JERSEY

ORIGINAL BOONTON 202B



THIS CKT SHOWS SERIOUS 60 HZ FM OF THE OSC. DUE TO HEATER-CATHODE LEAKAGE IN V5 6AK5 REACTANCE MOD.



THIS MOD PUT IN 1-11-78 FOR D.C. OPERATION OF RF SECTION FILAMENTS REMOVED THE 60 HZ FM.

APPENDIX

LIST OF ILLUSTRATIONS

APPENDIX

OUTPUT CONNECTIONS

A. The method of connecting the load to the 202-E Signal Generator or to the 207-E Univerter must be considered to insure proper interpretation of results, and the following discussion is offered as an aid to the user.

It is convenient to represent a signal source in terms of its open circuit voltage and internal impedance.* Thus a signal source or an antenna can be represented as in Figure 1. For simplicity, only the case where source and load impedance are resistive will be considered.

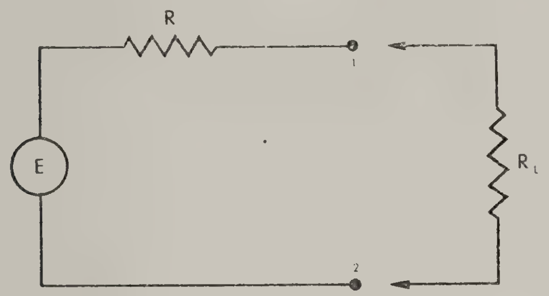


Fig. 1 Signal Source Representation

E — open circuit voltage
R — impedance looking into terminals 1 and 2
R_L — load impedance

For purposes of rating sensitivity, the input to a receiver might have been defined initially either as the open circuit source voltage E or the voltage actually across the receiver's terminals. The Institute of Radio Engineers has established the former method as standard and defined receiver input in terms of the open circuit voltage of the source.**

The impedance of the signal source employed to test receivers should be equal to the impedance of the antenna with which the receiver is designed to operate. Note that in this case the voltage actually across the receiver terminal is $\frac{E}{2}$ (Receiver input impedance equal to source impedance.)

**General Radio Experimenter, Vol. XXI, No. 1, June, 1946.*

***The Institute of Radio Engineers, Section 4.01.01, 1947, Standards on Radio Receivers, The Institute of Radio Engineers, Section 4.01.01, 1948, Standards on Television.*

B. *Accessories* for physically connecting the instrument to the load are described in the following:

1. *501-B Output Cable (supplied with 202-E)*

A 501-B Cable attached to the 202 or 207 is illustrated by Figure 2, where R_2 is the 50 ohm termination of the 501-B cable. The equivalent circuit (Figure 3) is readily determined by applying Thevinin's theorem. This arrangement is recommended for general use where it is desirable to connect the 202 or 207 output to an input circuit of relatively higher impedance than 25 ohms. The attenuator of the 202 will read the output directly.

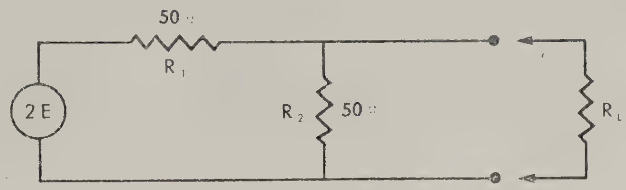


Fig. 2 Output Circuit of 202-E or 207-E with 501-B Output Cable Attached

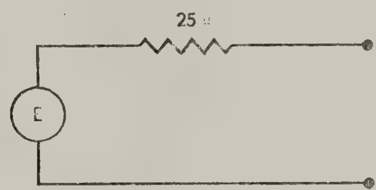


Fig. 3 Equivalent Output Circuit of 202-E or 207-E with 501-B Output Cable Attached

E — 202 attenuator dial reading
R_1 — internal resistance of 202 or 207
R_2 — 501-B cable termination
R_L — load impedance

2. *505-B, 6db Pad*

This pad is used as a dummy antenna in testing unbalanced receivers with a 50-ohm input as shown in Figure 4.

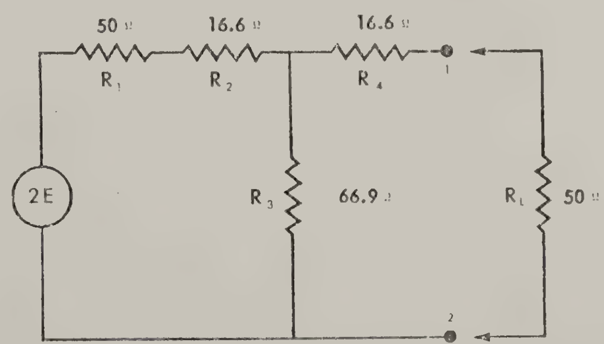


Fig. 4 505-B T-Pad as Dummy Antenna for Receiver

E — 202 attenuator dial reading
R_1 — internal resistance of 202 or 207
R_2 — pad resistance

R_3 — pad resistance
R_1 — pad resistance
R_L — load impedance

The open circuit voltage appearing across terminals 1 and 2 is by Ohms law (equation 1) equal to E, half of the source voltage. Applying Thevinin's theorem

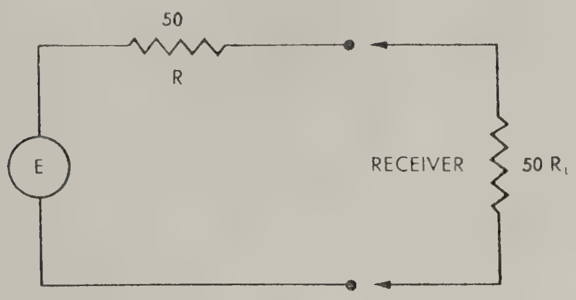


Fig. 5 Equivalent Circuit of a 505-B T-Pad as an Antenna

the equivalent circuit of Figure 5 is obtained, and thus the attenuator dial of the 202 reads receiver sensitivity directly for the assumed standard output.

3. *509-B 20 db T-Pad (Supplied with the 207-E)*

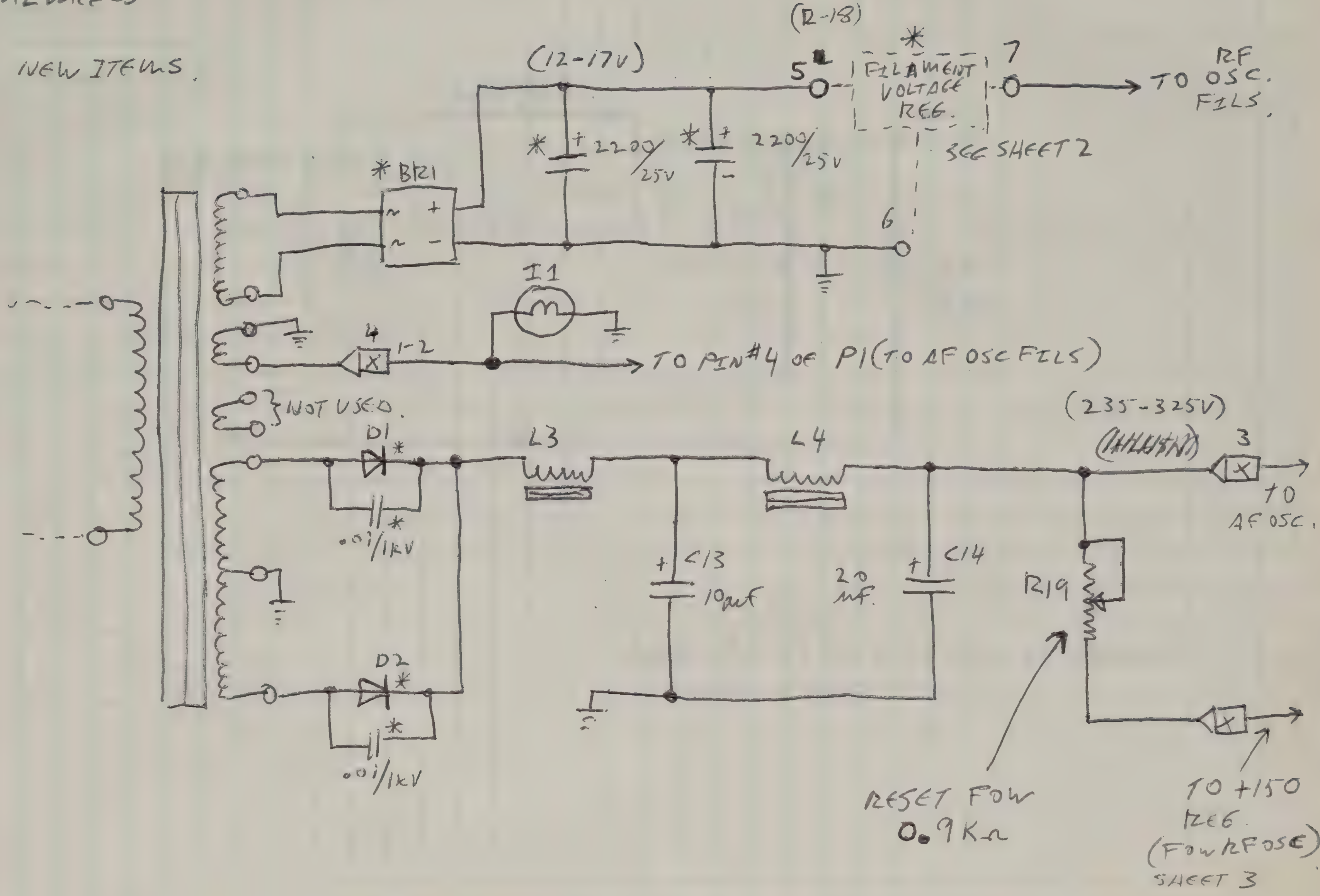
This pad is useful where signal levels are required which are low compared to the constant noise level of the 207. Since the noise level of the 207 is constant, the signal to noise ratio varies directly as the signal level. Therefore, with low output voltage the signal to noise ratio may be improved by increasing the input voltage and attenuating the output. For practical purposes the 20 db pad is useful at output levels below 500 microvolts for the 202-E. The signal applied to a 50-ohm load may be found by dividing the 202 attenuator dial reading by ten.

The 509-B pad, like the 505-B, may be used as a dummy antenna except that the measure of receiver sensitivity (equivalent source voltage) is one-fifth the 202 attenuator dial reading.

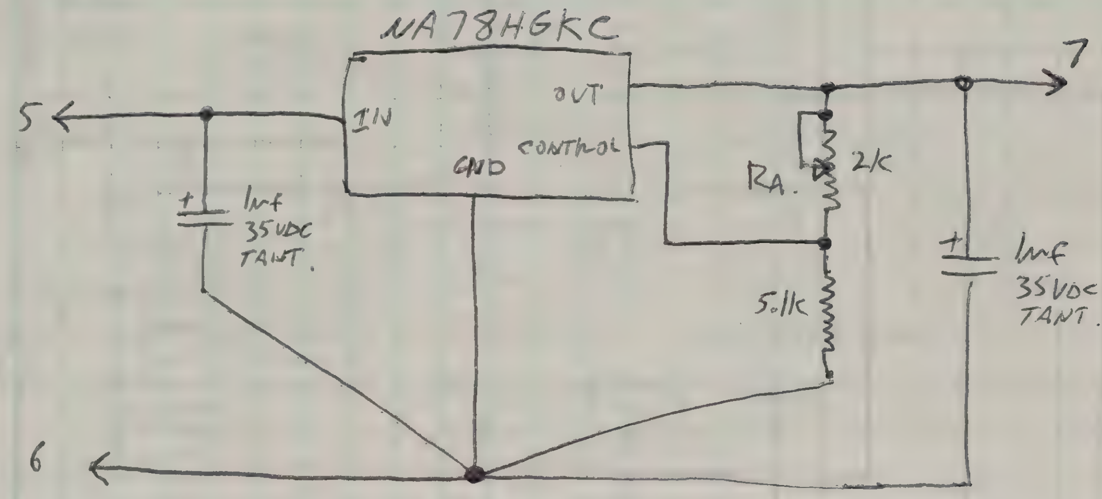
BOONTON 202-B

PWR SUPPLY MOD.
SHEET 1 OF 3.
18 FEB 84 MLWEELS

* INDICATES NEW ITEMS.



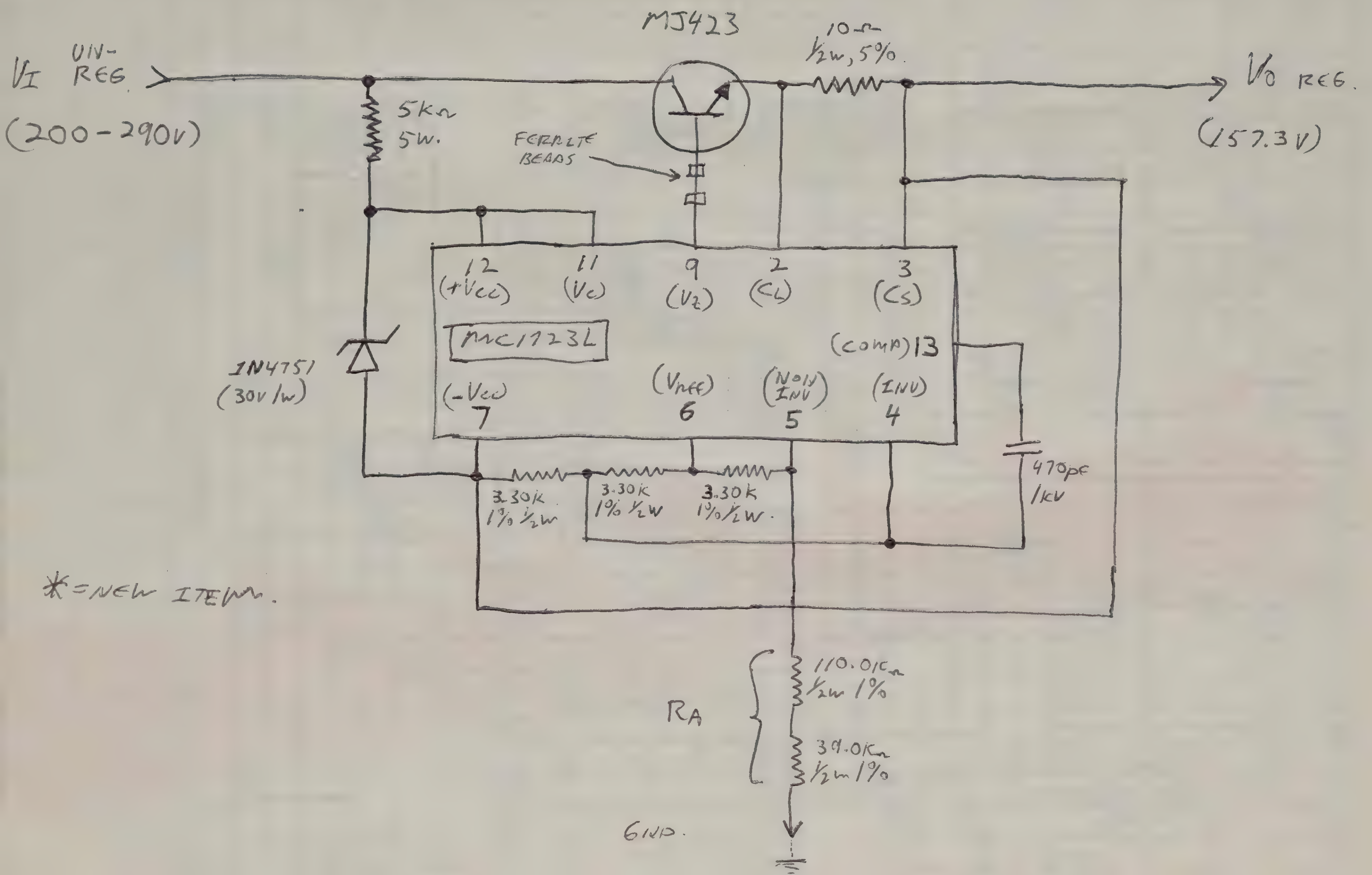
* FILAMENT VOLTAGE
REGULATOR.



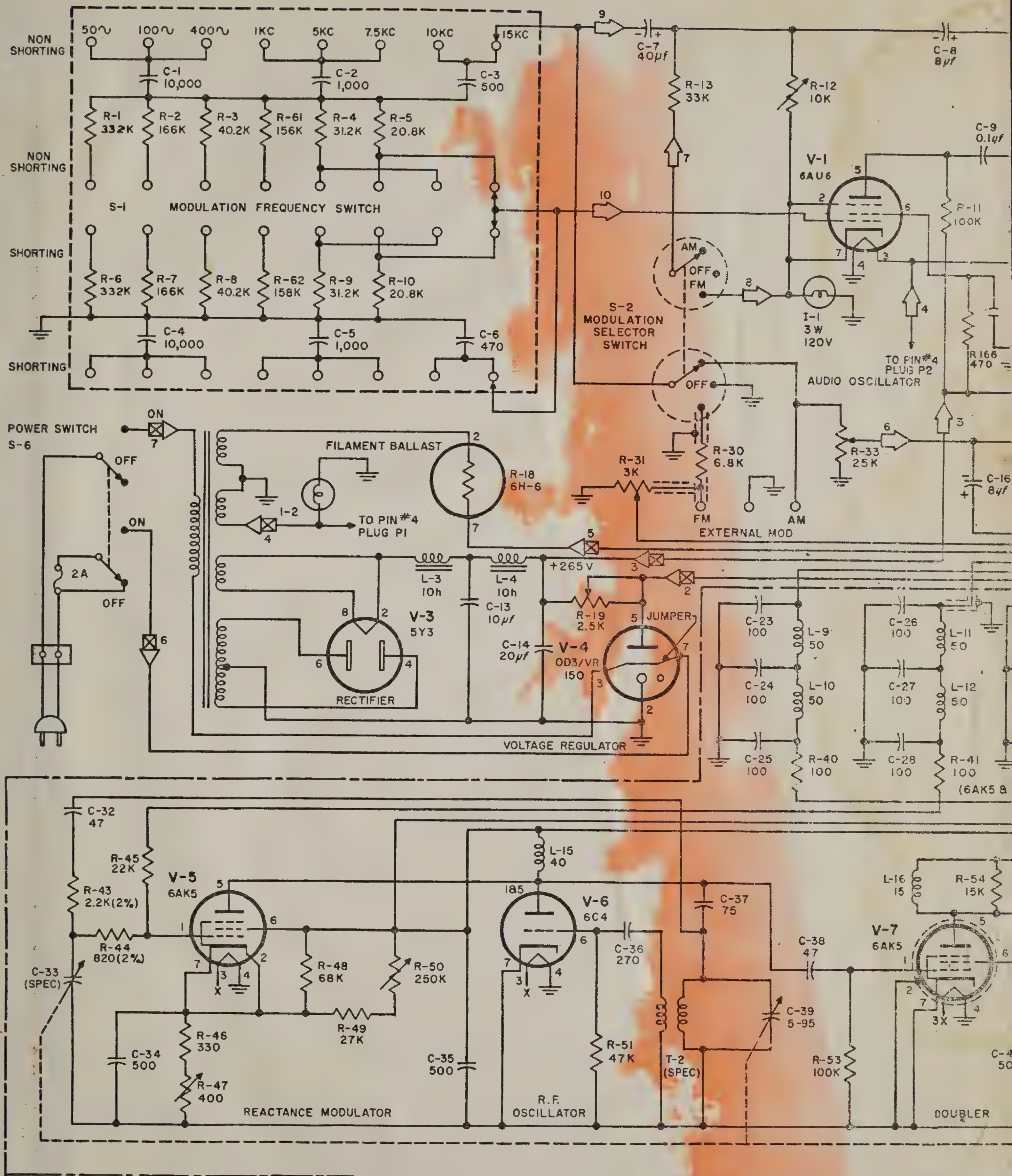
*=NEW ITEM.

ADJ RA FOR 6.45 VDC AT CHASSIS
OCTAL SOCKET PIN 7

* +150V VOLTAGE REGULATOR.



*=NEW ITEM.


NON SHORTING
50∿
100∿
400∿
1KC
5KC
7.5KC
10KC
15KC
C-1 10,000
C-2 1,000
C-3 500
R-1 332K
R-2 166K
R-3 40.2K
R-61 156K
R-4 31.2K
R-5 20.8K
NON SHORTING
S-1
MODULATION FREQUENCY SWITCH
SHORTING
R-6 332K
R-7 166K
R-8 40.2K
R-62 158K
R-9 31.2K
R-10 20.8K
C-4 10,000
C-5 1,000
C-6 470
SHORTING
C-7 40μf
R-13 33K
R-12 10K
C-8 8μf
C-9 0.1μf
V-1 6AU6
R-11 100K
AM
OFF
FM
S-2 MODULATION SELECTOR SWITCH
I-1 3W 120V
TO PIN #4 PLUG P2
R 166 470
AUDIO OSCILLATOR
OFF
R-30 6.8K
R-31 3K
R-33 25K
C-16 8μf
FM
AM
EXTERNAL MOD
POWER SWITCH S-6
ON
OFF
2A
OFF
ON
FILAMENT BALLAST
R-18 6H-6
I-2
TO PIN #4 PLUG P1
L-3 10h
L-4 10h
+265 V
C-13 10μf
R-19 2.5K
JUMPER
V-3 5Y3
RECTIFIER
C-14 20μf
V-4 OD3/VR 150
VOLTAGE REGULATOR
C-23 100
L-9 50
C-24 100
L-10 50
C-25 100
R-40 100
C-26 100
L-11 50
C-27 100
L-12 50
C-28 100
R-41 100
(6AK5 8
C-32 47
R-45 22K
V-5 6AK5
R-43 2.2K(2%)
R-44 820(2%)
C-33 (SPEC)
R-48 68K
R-50 250K
R-49 27K
C-34 500
R-46 330
R-47 400
REACTANCE MODULATOR
L-15 40
V-6 6C4
C-36 270
C-37 75
C-35 500
R-51 47K
T-2 (SPEC)
C-39 5-95
R.F. OSCILLATOR
L-16 15
R-54 15K
C-38 47
V-7 6AK5
R-53 100K
DOUBLER

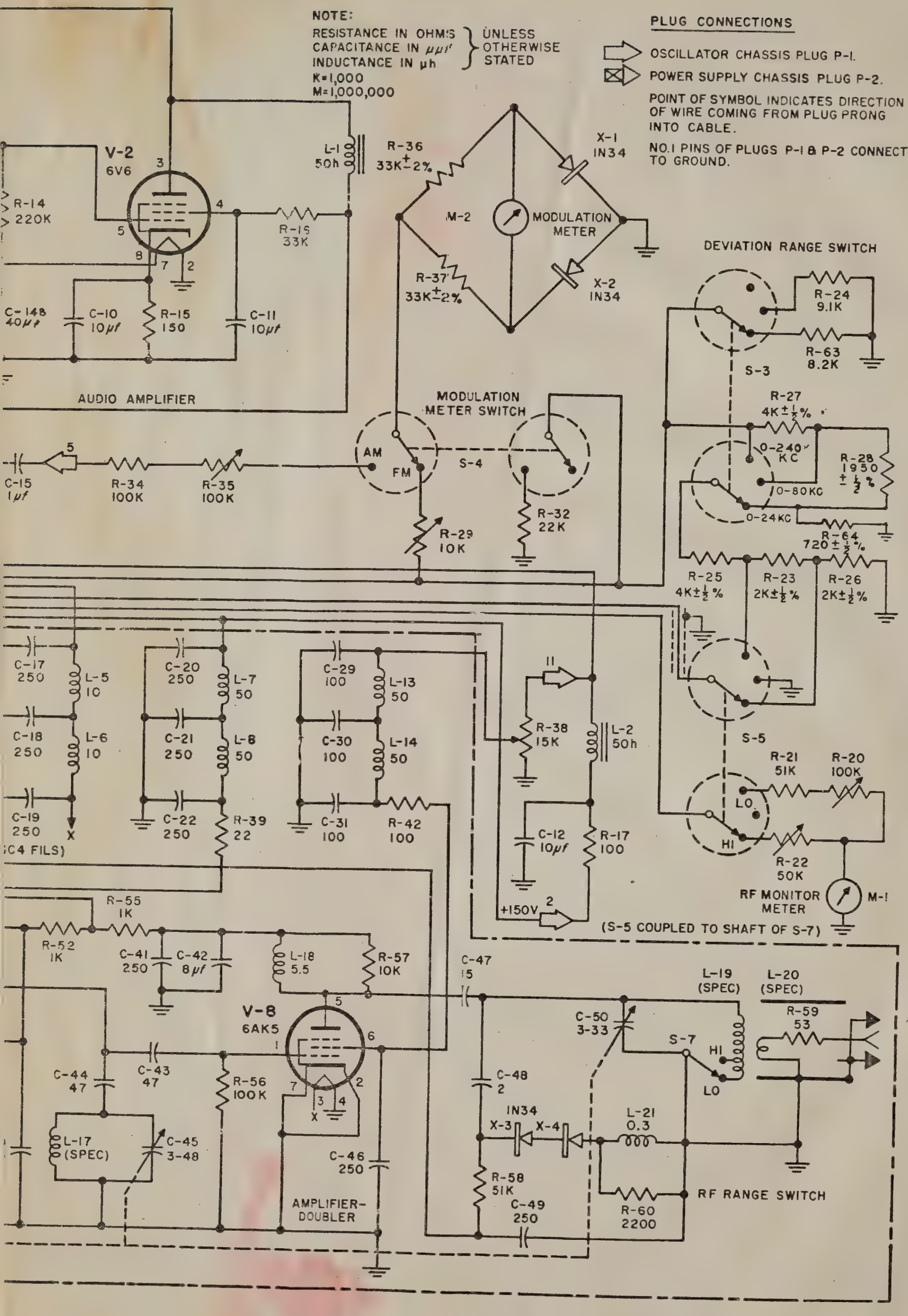


Fig. 8. Schematic Wiring Diagram of 202-B FM Signal Generator

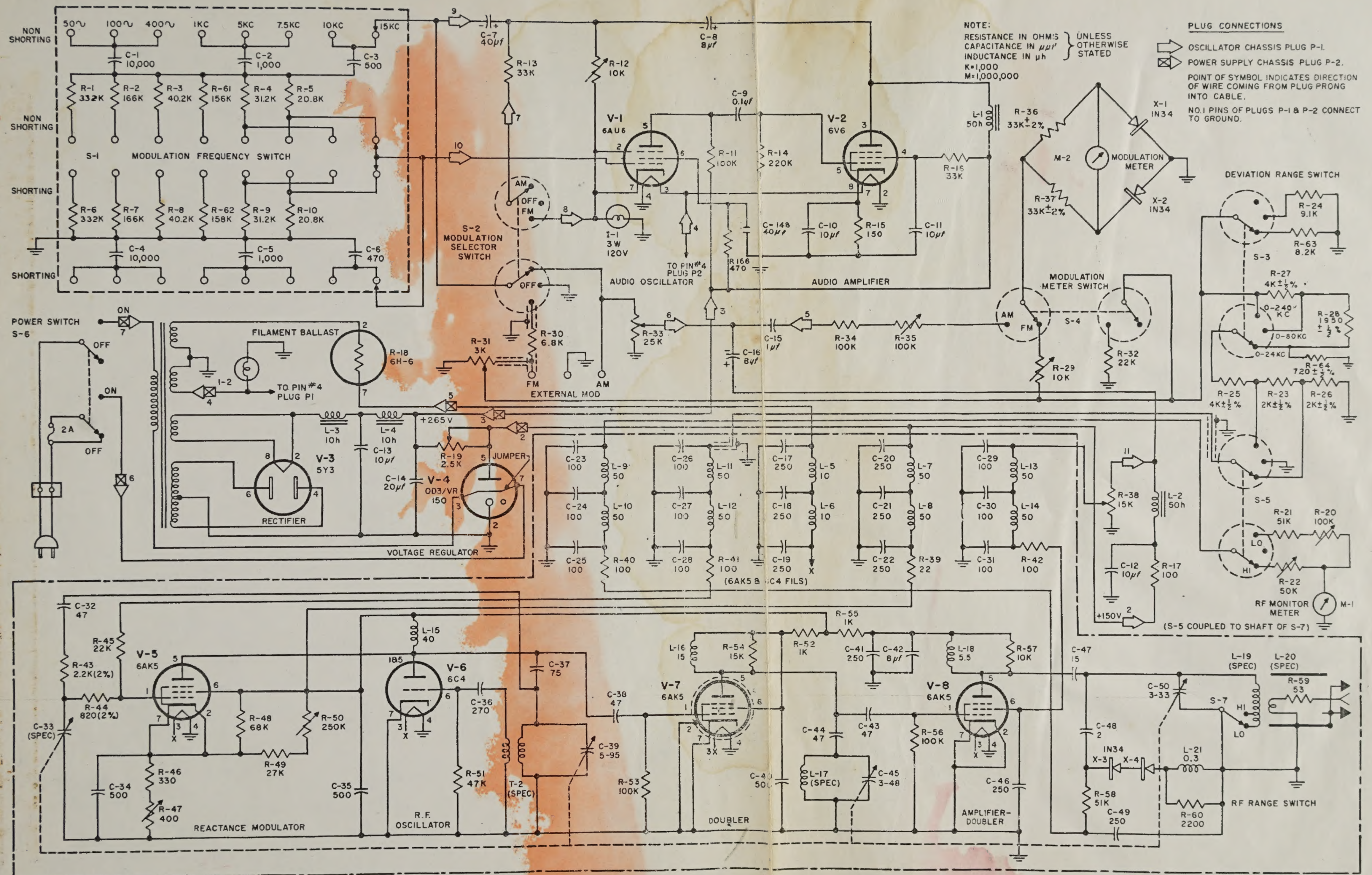


Fig. 8. Schematic Wiring Diagram of 202-B FM Signal Generator